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Plating

THE MONTHLY REVIEW OF THE AMERICAN ELECTROPLATERS' SOCIETY

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Filtration in a Modern Plating Plant

Mechanical Finishing with Roto-Finish Techniques

Porosity of Electrodeposited Metals

Methods for Testing Thickness of Electrodeposits

Manual for Electroplaters' Science Course

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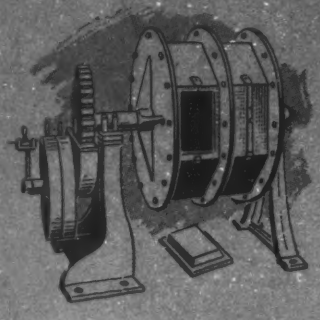
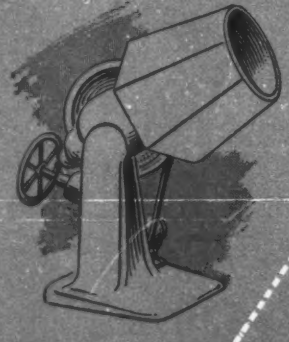
CLEPO 10-D PROCESS





FOR CLEANING AND BURNISHING STEEL PARTS IN ONE OPERATION WITHOUT USING BURNISHING SHOT

The Clepo 10-D Process greatly reduces the operation time and also the high cost of the conventional method of soak cleaning plus ball burnishing.

The Clepo 10-D Process is adaptable for use in either oblique or horizontal steel tumbling barrels. Oblique barrels are usually preferred because of time saved in rinsing, loading, and unloading operations.

We will be very glad to arrange a demonstration of this process at your convenience at your plant.

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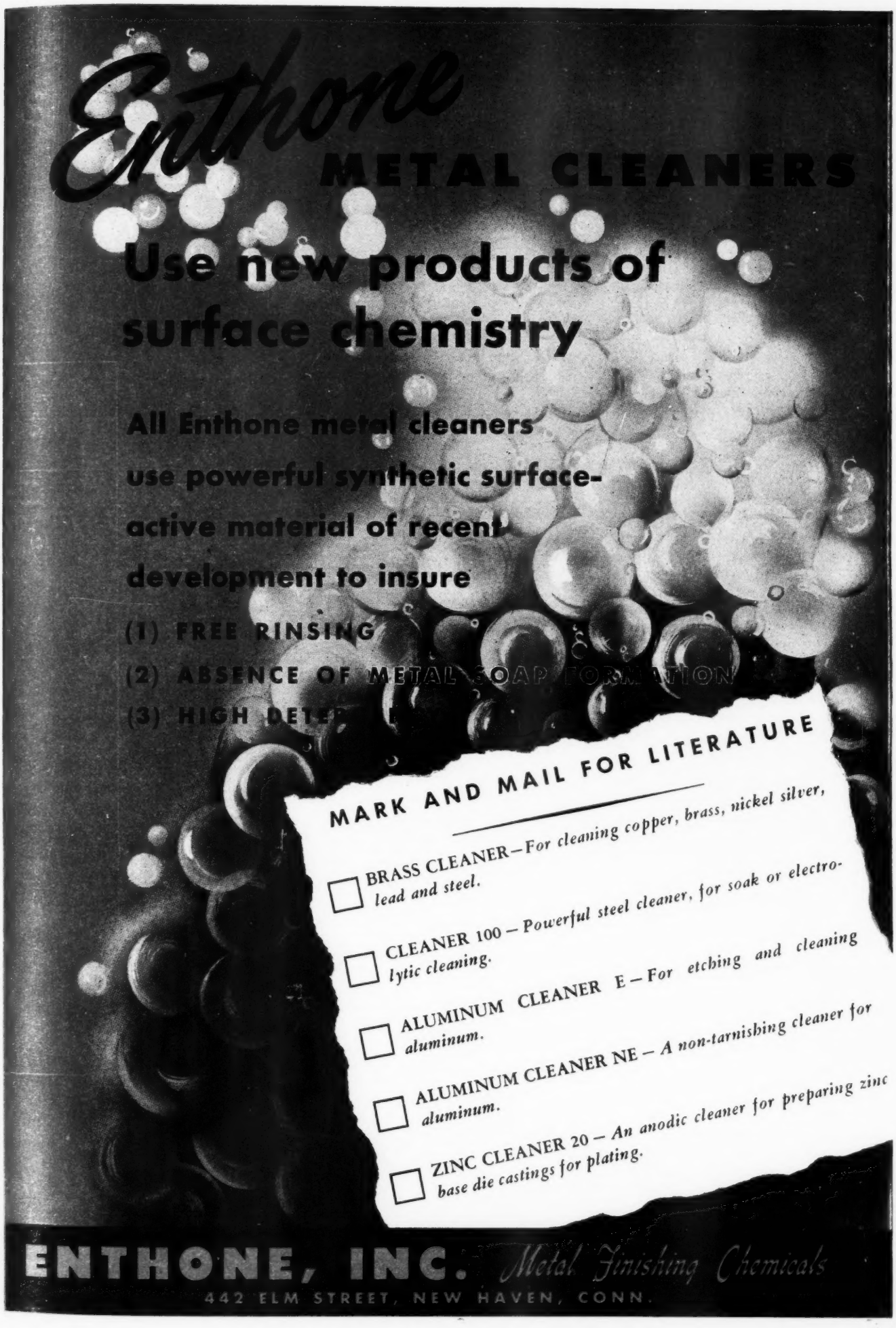
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METAL CLEANERS
Use new products of surface chemistry
All Enthone metal cleaners use powerful synthetic surface-active material of recent development to insure
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(3) HIGH DETER
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BRASS CLEANER—For cleaning copper, brass, nickel silver, lead and steel.
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ALUMINUM CLEANER NE—A non-tarnishing cleaner for aluminum.
ZINC CLEANER 20—An anodic cleaner for preparing zinc base die castings for plating.
ENTHONE, INC. Metal Finishing Chemicals
442 ELM STREET, NEW HAVEN, CONN.

Industry News

Wilson C. Blake Company, 190 Beacon Street, Hartford, Conn., active in the engineering and sale of heating and power plant equipment for twenty-four years, has been appointed distributor of Dravo "Counterflo" Heaters in Connecticut and Western Massachusetts, by Dravo Corporation, Pittsburgh, Pa.

The Dravo heaters, fired by gas, oil or coal, are used for comfort heating, summer ventilating, process heating and drying, and tempered make-up air. They are widely used in all types of industrial and commercial structures.

Charlotte, N. C., District Sales Offices of the Du Pont Company have opened new headquarters in a building erected for them at 427 Fourth Street

The structure is brick, fully air conditioned, and newly equipped and furnished to serve Charlotte region customers of four of Du Pont's ten operating departments—Organic Chemicals, Rayon, Grasselli Chemicals, and Electrochemicals. The district sales offices of the Electrochemicals Department will be on the second floor. There will be the offices of D. C. Newman, Southern sales manager, and L. R. Kennette, Charlotte district sales manager for Electrochemicals.

The new property has its own ample parking facilities adjoining it.

Charles F. L'Hommedieu and Sons Company of 4521 Ogden Avenue, Chicago, Ill., has recently celebrated its 50th anniversary. It was in May, 1898 that the founder of this company opened the store at 34 N. Canal Street near Lake Street in Chicago with a few platers' and polishers' supplies which since has grown to include plants in Chicago and Grant Park, Ill., and branches in Los Angeles and Cleveland.

Charles F. L'Hommedieu was born in West Stockbridge, Mass., on June 28, 1844. He learned silver plating as a young man employed in the plating department of Meriden Britannia Company, now the International Silver Company, and later worked as a plater in Boston, Philadelphia, Rockford and Chicago. He died in Los Angeles on March 19, 1937 and was succeeded to the presidency of the company by his son, Arthur W., who with his brother Charles Edward and sister Alice Margaret was one of the incorporators of the business in 1906.

The old cash book of the company, kept by Miss L'Hommedieu and dating from 1900–1903, shows the names of several concerns which have been customers ever since that time, among them Chicago Hardware Foundry Company, Garden City Plating Company, Frank Holton Company, McGill Manufacturing Company, National Brass Company, National Stamping Company, F. H. Noble Company.

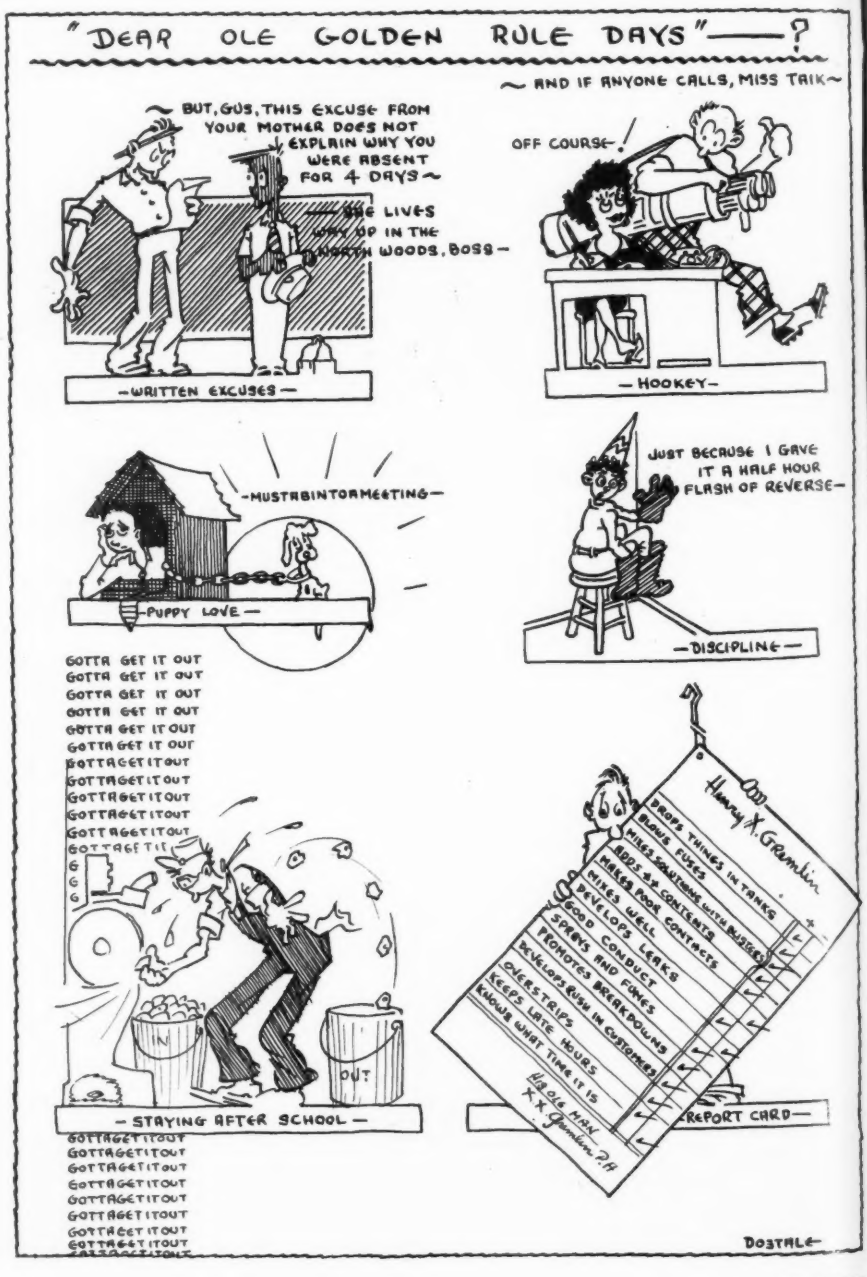
A 28-page booklet was issued to commemorate the event. It is profusely illustrated with pictures of company personnel, plants, and equipment, past and present, and gives an excellent view of the progress made during the past five decades.

Our congratulations at this milestone of service to the industry!

E. F. Houghton & Company of Canada, Limited, manufacturer of cleaning compounds and other industrial chemicals, began operations in its new Toronto plant on July 15, under the direction of E. H. MacInnis, Vice-President and Director of Sales.

Located at 100 Symes Road in Northwest Toronto, the new plant property covers 2½ acres of ground and is geographically situated so as to take full advantage of both rail and motor shipping facilities.

Twenty-three years ago E. F. Houghton & Company of Canada, Limited, was incorporated in Canada and opened a sales office in Toronto following several years of selling through concessionaries. In 1932 increased sales necessitated the manufacturing of Houghton products in Canada to insure faster delivery. This was done in a leased plant on Dufferin Street. The Houghton Canadian sales



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The Promat organization has devoted many years to research and development in the field of metal finishing, both protective and decorative. Our Waukegan plant has extensive laboratories in which new products are developed and tested under production conditions before they are released.

It is our aim to have all Promat products and processes produce higher quality finishes with maximum efficiency and at the lowest costs consistent with high quality.

The Promat Division, backed by the experience and resources of Poor & Company, long established suppliers to the American railroads, will continue to develop and offer new and better products to the electrochemical and metal finishing industries.

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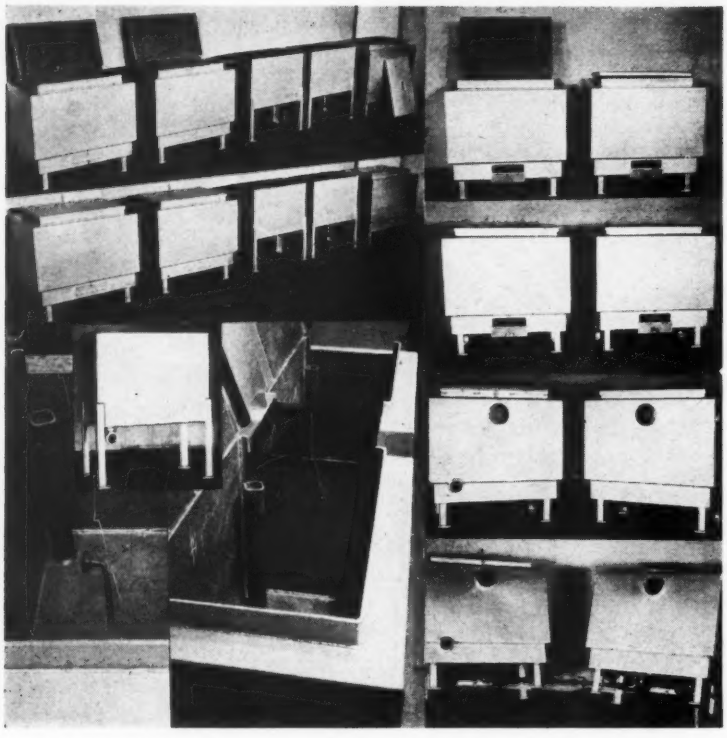

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Plus Economy
IN YOUR BATH TANKS

Cut your operating cost by designing for low fuel consumption and long service life

EXPERIENCE with Storts design and construction in many installations of controlled temperature bath tank cycles has proved that maximum heating efficiency and low operating cost are accomplished through correct detailing of hot air chambers, fume outlets, insulating chambers and insulation. Drain connections and overflow pipes, ignition openings and hinged doors, gas burner mountings, electrical immersion heater connections and steam heating coils can be Stortswelded in whatever arrangement and location tends to make each tank a self-contained unit of the greatest utility. When in need of single tanks or complete cycles, let Storts engineering staff assist you in planning such details—so as to hold your operating costs at a minimum.

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INCORPORATED
42 Stone Street Meriden, Conn.

Manufacturers of Welded Fabrications to Specifications

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Industry News

organization today includes twelve representatives covering all of Canada from Vancouver to and including the Maritime Provinces. These men have an aggregate of 150 years of sales and service experience. British Columbia is covered by Production Supply Company, Houghton representative in Vancouver.

Foxboro Company, San Francisco Branch, having acquired the remaining space in the building which it occupies at 266 Fremont Street, is now settled in its rearranged quarters, with practically double the working space previously available. The company, which has its main office and factory in Foxboro, Mass., is one of the leading makers of industrial instruments for measurement and control of process variables such as temperature, pressure, humidity and flow. The San Francisco branch is a sales office and warehouse for Foxboro products and also a branch factory providing repair service for customers in the West Coast territory. The shop is also fully equipped to assemble new Foxboro instruments and control valves, when time does not permit their shipment from the main factory.

Industrial Corrosion Control, Inc., whose chief service is lining industrial equipment with anti-corrosive coatings, has been recently incorporated under the direction of R. G. Forsberg, president. Forsberg also serves as president of Penn-Ohio Industrial Sales Company, suppliers of industrial equipment and Pittsburgh representative for Industrial Corrosion Control, Inc. He was formerly associated with Jessop Steel Company as purchasing agent and with Timken Roller Bearing Company.

General Sales Offices for Industrial Corrosion Control, Inc., will be maintained in the Empire Building, Pittsburgh, Pa., with James D. Clokey, Jr., as Sales Manager. Mr. Clokey was formerly general manager of sales for Washington Steel Corporation, Washington, Pa., stainless steel specialist for Superior Steel Corporation, Carnegie, Pa., and also associated with Carnegie Illinois Steel Corporation. Sales representatives for Industrial Corrosion Control, Inc., are located throughout the principal cities of the United States.

The plant, located at Neville Island, Pittsburgh, maintains complete facilities to line industrial equipment with Vinyl Plastisol, a thermosetting plastic which has proven highly successful as a protective agent against corrosion in industry.

The National Association of Metal Finishers, with headquarters in Detroit, Mich., held its 3rd Annual Meeting in Atlantic City, N. J., on June 27, in con-

ALUMINUM CLEANING MADE EASY

When you use Cowles Aluminum Cleaners you reduce your cleaning problems to a minimum.

Cowles A E Cleaner is a low pH cleaner with synthetic emulsifying and wetting agents designed for both still tank and electrocleaning of aluminum. It is fast-acting and free rinsing. It is economical to use because of its long life in solution. Cowles A E Cleaner is non-etching—will not attack the aluminum at high concentrations and high temperatures.

Cowles 352 Cleaner is especially designed for pressure type and other standard type washing machines. It incorporates all of the desirable characteristics of A E Cleaner but *will not foam.*

COWLES TECHNICAL SERVICE ON REQUEST

Your Cowles Technical Man is especially qualified to render service on all cleaning problems on aluminum and its alloys.

PROMPT SHIPMENTS FROM LOCAL STOCKS

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Metal Cleaner Department

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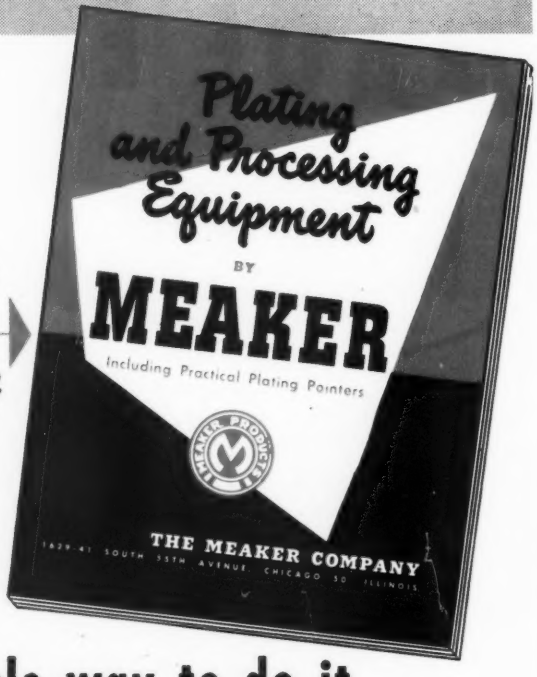
New a complete booklet!

ELECTROPLATING MACHINES

"Tailored to Fit"

PRACTICAL PLATING POINTERS

Plating Data Tables



Write for Your Copy

the profitable way to do it

Making every operation in a plating sequence as automatic or as mechanized as possible is the profitable way. This new booklet illustrates and describes a variety of ways it is done with Meaker Machines Not only is the cost lower, but the production is increased, and a better and more uniform quality of product is assured.

You should get a copy of this booklet for ideas on improving your plating processes. The Practical Plating Pointers including several new tables are a convenience for those in charge of plating departments.

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Full Automatic and Semi-Automatic Electroplating Equipment • Strip Steel Plating Equipment • Wire Galvanizing Equipment • Strip Steel Electrocleaning Lines • Pickling Machines • Processing Conveyors Motor Generators for Plating • Rectifiers for Plating

Industry News

junction with the 35th Annual Convention of the American Electroplaters' Society.

The association is composed of individual job platers through the country and is also a federation of local and regional associations in Boston, Chicago, Detroit, Kansas City, Los Angeles, New York, San Antonio, and St. Louis.

Officers elected for the coming year were: *President*, Paul Henning, Detroit Plating Industries, Detroit, Mich.; *First Vice-President*, R. A. Campisi, Industrial Enameling Corporation, Boston, Mass.; *Second Vice-President*, H. E. Coombes, Crown City Plating Company, Pasadena, Calif.; *Third Vice-President*, D. J. Griffin, Birmingham Plating Works, Birmingham, Ala.; *Treasurer*, W. O. Zinn, National Plating Company, Chicago, Ill., and *Executive Secretary*, Raymond M. Shock, Detroit, Mich.

Among the accomplishments of the past year which were reviewed are the following:

1. Reduction of permissible exports of chromic acid so that more of it was made available to the job platers throughout the country.

2. Publication of a Metal Finishing Manual with technical and financial data to aid the job plater in his business.

3. Publication of the first national directory of job platers and finishers which cross-indexes, geographically, every type of plating and finishing service rendered by its members.

According to Raymond M. Shock, Executive Secretary, plans for the coming year include continued work to relieve scarcity of items required by the job platers, and increase of membership by formation of additional local associations and through individual memberships where no local associations exist.

Brown Instrument Company has recently made another large increase in its branch and regional sales and service staffs according to William H. Steinkamp, field sales manager of the industrial instrument division of Minneapolis-Honeywell Regulator Company. The latest increase in the field staffs confirms the growth of the company's business and its recently announced expansion of production facilities. The additions to the sales and service staffs and the cities to which each engineer has been assigned are as follows:

Atlanta: G. L. Ferguson, sales
Baltimore: Wayne Cook and Carl Lower, service
Boston: Warren N. Smith and Albert E. Phillips, service

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MAXIMUM VENTILATION-

For the Entire Life of the Buff!

CODMAN'S New REAL-VENT* Ventilated Non-Fray Buff with its revolutionary thin pressed center gives you longer, more efficient service. Its ventilating channels will not break down even under abnormal pressures, and the new "thin center" allows a denser face. These two outstanding features of the REAL-VENT add up to longer buff life and greater profits. Investigate the real possibilities of increased production in your plant with Codman's REAL-VENT BUFFS. Write today!

*The REAL-VENT Non-Fray Ventilated Buff is made under patent nos. 2,027,863; 2,094,650; 1,573,961; Re. 19,894; 2,143,208, other patents pending.

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DETROIT
LOS ANGELES
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THE Siefen System*

SPRAY EQUIPMENT
SPRAY COMPOUNDS
SPRAY SERVICE

*This is one of a series of messages describing the modern way of applying buffing and polishing compounds by spraying on revolving wheels. Rapidly becoming known as "The Siefen System" this system, based on Equipment, Compounds, Service, will step up your speed and efficiency while materially reducing your costs.

THE PROPER EQUIPMENT

SIEFEN experience has developed spray guns specially designed for spraying compound. Siefen guns assure correct mixture, and with proper care, will not clog, and are easily mounted in proper position for your specific job. Siefen valves, automatic cam or foot operated, hoses and fittings, the new Siefen circulating pump, pressure tanks or gravity cups installed according to our recommendations will help increase your production.

REMEMBER—
The Siefen System

1. SIEFEN EQUIPMENT
2. SIEFEN COMPOUNDS
3. SIEFEN SERVICE

J. J. SIEFEN COMPANY
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Industry News

Charlotte: W. Williamson, Jr., service; R. J. Holt, sales

Chicago: Bernard Fuller and Ormond Herring, sales

Cleveland: R. Schumaker, sales

Denver: Robert Koening, service

Detroit: W. De Wolf, service

Dallas: Robert Harris, Jr., sales

Houston: C. D. Walker, sales

Indianapolis: Barry Coleman and Robert Thomas, service

Los Angeles: Richard Corbin, service; Ralph Imbrogno, sales

New York City: A. Godfrey, sales; Ernest P. Lang, William C. Meyer and Edward J. Roach, service

Philadelphia: A. L. Rogers, Jr., sales; Albert T. Collins, Joseph Facer and Edward A. Lytle, service

St. Louis: Keith H. Webb, service

Syracuse: Richard Caviniss and George Wilson, service

Washington, D. C.: John R. Shea, service

Kansas City: D. W. Rees, service

Omaha: H. C. Klug, sales

East Orange, N. J.: William Harris, sales

Turco Products, Inc., 6135 S. Central Avenue, Los Angeles 1, Calif., has chosen McCook, Ill., the site of the new, modern plant for the manufacture of industrial cleaning compounds. The new plant is a necessary addition to Turco's present manufacturing facilities in Chicago, Los Angeles and Houston.

Many factors combine to make McCook an ideal location. Its availability to various sources of raw materials and its central location for distribution of finished compounds makes possible more rapid service and equalization of freight charges to Mid-West aad Eastern markets.

Third National Instrument Conference and Exhibit, sponsored by The Instrument Society of America, will be held in Philadelphia Convention Hall on September 13–17. Participating in the conference are the American Society of Mechanical Engineers, the American Institute of Physics, and the American Institute of Electrical Engineers. The not less than 15 sessions are to be devoted to Ordnance instruments, temperature and pressure elements, automatic control, control valves, scientific instruments, process control, electronics, cascade controls, control instrumentation, electronic instruments, and crime detection instruments. Some 150 firms will have booths at the Exhibit.

Complete program may be had by writing the Society at 1117 Wolfendale Street, Pittsburgh 12, Pa.

FOR FURTHER INFORMATION, USE READER SERVICE CARD: INDICATE A 614.

The new "SCOTCH" Tape No. 470, for electroplating, meets the industry's long standing need for a quickly applied protective material to cover or repair electroplating racks and to block off areas that are not to be plated. "SCOTCH" Tape No. 470 has a strong, stretchable plastic backing which is unaffected by acids, alkalies, water-fresh and salt, alcohols and hydrocarbons. The pressure sensitive adhesive takes hold on contact and will stand long immersion in plating solutions and cleaners.

Quickly unwound and applied from a handy roll . . . "SCOTCH" Tape No. 470 requires no application or removal equipment. The pressure sensitive adhesive takes hold on contact and sticks tightly until its job is done. Then it comes off easily, leaving no adhesive sticking to the object that has been plated. The elastic backing conforms snugly to odd-shaped and irregular surfaces.

Prolonged immersion in hard chrome plating does not cause cracking or brittleness.

To find out what this great new electroplating tool can do for you, write for a free sample to try in your own work.

REG. U.S. PAT. OFF.

SCOTCH BRAND TAPE

No. 470 YELLOW FOR ELECTROPLATING

ANOTHER 3M COMPANY PRODUCT

Made in U.S.A. by MINNESOTA MINING & MFG. CO. St. Paul 6, Minn.

A NEW ORDER OF DURABILITY IN METALS

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ALUMINUM
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ANCHORS THE FINISH
RETARDS CORROSION

NO ELECTRIC CURRENT

NO SPECIAL SKILLS

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SHORT PROCESSING TIME

Economical for either small or large plant operation, interrupted or continuous production. Write or call for descriptive folder on "Alodine".

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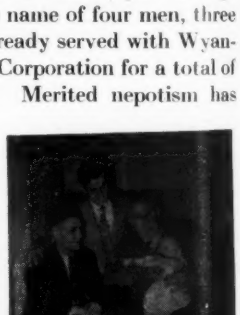
Personals

Arthur H. Lupson has recently been appointed Technical Equipment Manager of Ingram & Glass, Ltd., Haslemere, Surrey, England, Electrochemical Engineers, who market the "Cycloc" constant-potential, fully automatic selenium rectifier unit for electroplating.

A finalist in electrodeposition of the City and Guilds of London Institute, Mr. Lupson recently resigned from the well-known supply house of W. Canning & Company, Ltd., after more than fifteen years of service, interrupted by five years n the Royal Air Force spent mainly in supervising a large hard chromium installation for build up of worn airplane engine parts. For many years he has been a member of the Electrodepositors' Technical Society and has recently been elected to membership in the American Electroplaters' Society.

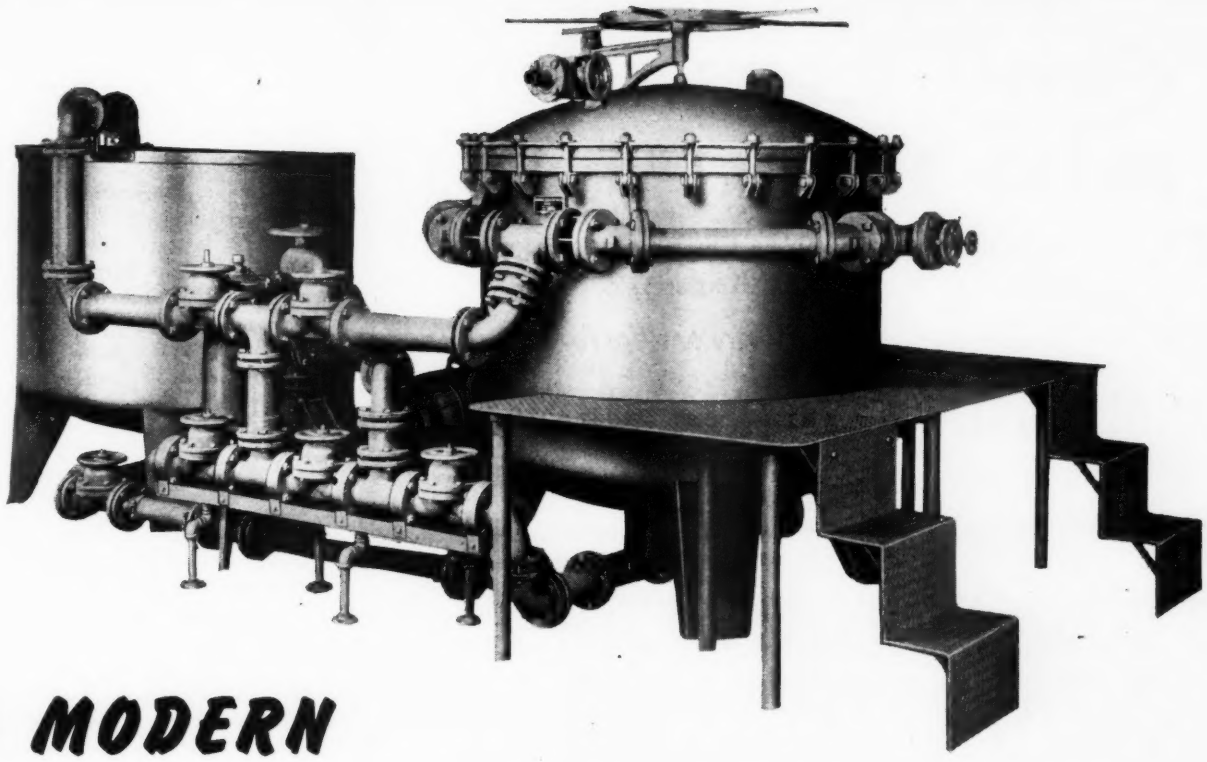
William S. Levine, until recently research associate with Prof. Serfass at Lehigh University on the very successful A. E. S. Research Project No. 2, "Determination of Impurities in Electroplating Solutions", received his Ph.D. degree on June 14. Our sincere congratulations and best wishes. Dr. Levine's address is now 104-04 97th Avenue, Ozone Park, L. I., N. Y.

William Sharlow, whose picture appears here, is the name of four men, three of whom have already served with Wyandotte Chemicals Corporation for a total of sixty-two years. Merited nepotism has been a successful policy during the fifty-eight years of this organization's existence, according to its employee magazine. Not only is E. M. Ford the fifth of his family to head the enterprises founded by his great-grandfather, J. B. Ford, but not less than 298 father-son, father-daughter and father-son-daughter combinations are in the company's employ today.

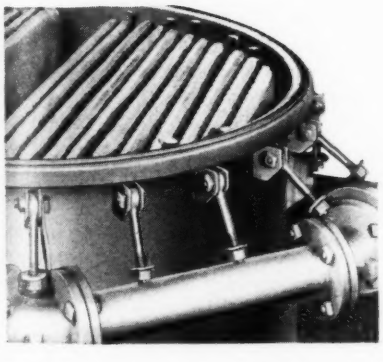


Sharlow

Julius W. Marx was recently appointed chief engineer of Newcomb-Detroit Company, builders of dust-arresting equipment and finishing systems.



A MODERN INDUSTRIAL LARGE CAPACITY FILTER SYSTEM



Top view of Filter Unit, illustrating arrangement of filter baffles as they are locked in the chamber. View also shows precoat of filter aid as it is deposited uniformly on the surface of the filter cloth.

Designed to provide adequate filtration on large automatic plating machines. Arrangement consists of filter, pumping unit, primer-strainer unit, mixing tank, control valves, fittings and piping. These features facilitate the convenient use of filter aids and purifying agents, making it an ideal continuous filtration system, equally effective for intermittent filtering. Systems are provided for either acid or alkaline solutions in sizes with up to 550 sq. ft. of filtration area.

INDUSTRIAL filters equipped with AIR WASH CLEANING FEATURE have been in operation for months without removing the cover. It is only necessary to remove the cover when new filter cloths are installed or for periodical inspection.

This time and labor saving method can only be used with our closed type vertical filters.

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COLUMBIA ELECTROPLATING MOTOR GENERATOR SETS

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Here's why Compress Wheels hold down your polishing costs!

- More area polished per pass
- More production because wheel heads last longer
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- Perfect balance . . . smoother operation
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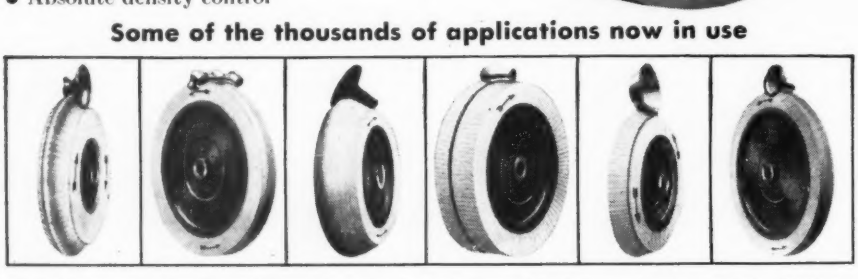
Some of the thousands of applications now in use



The Compress Polishing Wheel is only one of many Divine products—Buffs, Polishing Wheels, Contact Wheels, Lathes, Automatics, and hundreds of other items! It's Divine for *the complete line!*

For complete information write for Divine Compress Wheel folder

Divine Brothers Company

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Personals

Mr. Marx graduated in engineering from Michigan State College. He later joined the engineering staff of Fisher Body Division of General Motors. More recently, as plant engineer at General Motors Truck and Coach Division, Mr. Marx gained wide experience in the application and operation of all types of dust-arresting and finishing equipment.

Lawrence M. Muse has been appointed assistant to G. L. Hehl, general manager, industrial division of The Sherwin-Williams Company, and will have charge of developing and promoting industrial sales through Sherwin-Williams branches as well as in the general industrial maintenance field.

A native of Nashville, Tenn., he attended Morgan Preparatory School and in 1936 joined Sherwin-Williams as warehouse stockkeeper at Nashville. Later he was transferred to Chattanooga, Tenn., in graphic arts and trade sales work. He served with the armed forces as a bombardier-navigator from 1943 until 1945 when he returned to Chattanooga. In the interim he has served as manager of Sherwin-Williams branches at Johnson City, Tenn., and Miami Beach, Fla., and for the past year and a half has been assistant to W. B. Bell, director of Sherwin-Williams' southeastern district with headquarters in Atlanta, Ga.

J. C. Duke has been elected vice-president of the coated abrasives division and **J. A. Borden** vice-president of the "Scotch" tape division of Minnesota Mining and Manufacturing Company, St. Paul, Minn.

Mr. Duke joined the firm in 1921 and has been sales manager for the company's surface-coated abrasive paper and cloth, including products for metal working and wood working industries, auto refinishing trades, and retail stores.

Mr. Borden joined the firm in 1925 and for seven years has been sales manager for "Scotch" tapes, including the familiar transparent cellulose tape, 40 electrical tapes and more than 60 others for packaging, masking, sealing, decorating, and sand blasting.

Frederick G. Rodenburgh, New York District Sales Manager for the Pennsylvania Salt Manufacturing Company, retired July 16 after nearly fifty years of service with the company. Mr. Rodenburgh joined Pennsalt in 1899, when he was only sixteen, as an assistant in the New York sales office. He later became sales agent for the company at the New York office and in 1936 was named New York District Sales Manager.

The company, in announcing Mr. Rodenburgh's retirement, said that effective Monday, July 19, the New York sales

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LEAD & TIN FLUOBORATE
SOLUTIONS

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General Chemical Technical Information Manual LTF-1 contains extensive data on plating lead-tin alloys. Full details on bath make-up and operation, bath control analytical methods, analysis of deposits, etc. For your free copy, write General Chemical Fluorine Division, 40 Rector Street, New York 6, N. Y. or nearest office below.

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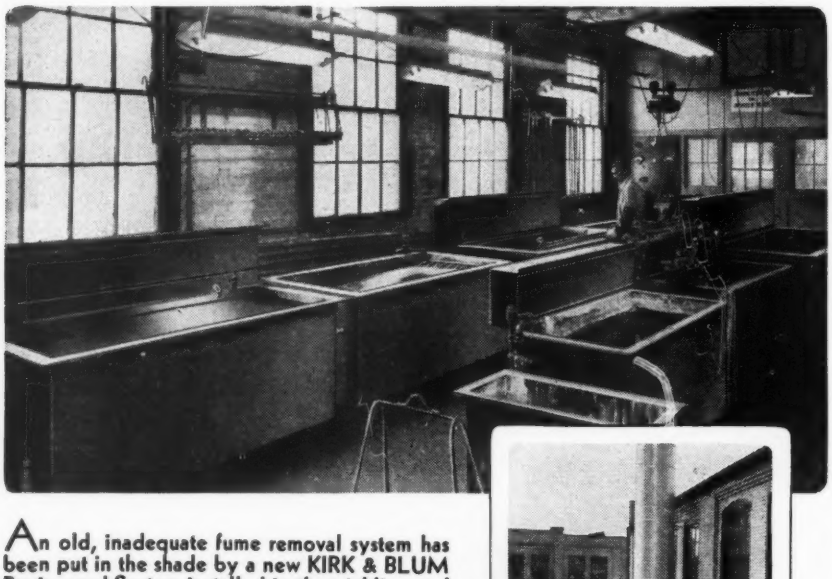

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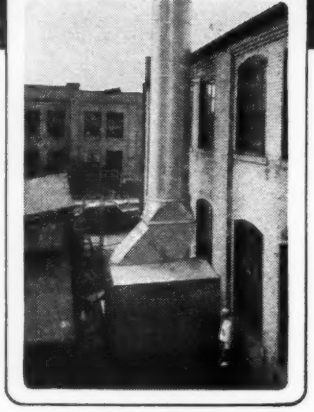

Fume exhaust and blower enclosure. Note clean, compact lines.

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Personals

office will be consolidated with the Paterson, N. J., sales office, located at 152 Market Street, Paterson 1. **Charles A. McCloskey,** District Sales Manager, will be in charge of the new consolidated office, which will handle Pennsalt sales in Eastern New York State, including the New York City metropolitan area, the New England States, and Northern New Jersey.

Mr. McCloskey, a graduate of the University of Michigan, joined Pennsalt in 1929. In 1931, he was named a sales representative for the New York office and in 1944 was appointed New York District Sales Manager, sharing supervision of the territory with Mr. Rodenburgh. He continued in that capacity until becoming Paterson District Sales Manager.

Mort Inglis has joined the sales staff of the Magnuson Products Corporation in San Francisco and Oakland. Through his experience as a consumer of industrial cleaning compounds and in the sales and service of such compounds and by his friendly and helpful attitude he is well

Inglis

qualified to assist consumers in the proper selection and use of materials for their requirements.

Warehouse facilities are now being expanded to afford prompt service to those in the Oakland-San Francisco area.

Morris R. Stanley has been appointed Assistant Director of Sales of Victor Chemical Works, manufacturers of phosphorus and phosphorus chemicals. Manager of the Planning Department for the past four years, Mr. Stanley will assume his new duties immediately. Since joining the company in 1923, his affiliation with Victor has been unbroken, except for the period of World War II when he served on the War Production Board, in Washington, D. C.

Edward G. Turner has been appointed to the Sales and Service Department of Canadian Hanson & Van Winkle Company, Ltd., Toronto, Ontario. He was formerly superintendent of plating at Sydenham Trading Company and for the last year and a half has held the same position with the Union Screen Plate Company at Lennoxville, Quebec. Mr. Turner will

Personals

live in Chatham and will serve the trade there and in the nearby cities of Windsor, Wallaceburg, Sarnia, and Watford.

Thomas A. Boaz has also joined the sales staff of Canadian Hanson & Van Winkle Company. Mr. Boaz has had a very wide experience in plating and polishing and leaves the Canada Cycle & Motor Company where he was Metal Finishing Superintendent. He will live in Toronto and will look after the Niagara Peninsula, part of Northern Ontario, and several accounts in and around Toronto.

Leonard R. Lindsey has been appointed Service Engineer for the Metal Industries Department of the Diversey Corporation. He will handle the sales and servicing of Diversey metal cleaning and surface preparation products in the Columbus-Dayton-Cincinnati area..

Victor F. Allen, formerly Superintendent of Phoenix Engineered Products and Giles Plating Industries, is a new addition to the sales and service department of W. W. Wells, Limited, Toronto, Ontario.

OBITUARIES

✝**George W. Dolan,** Chairman of the Board of Directors of Mathieson Chemical Corporation (formerly The Mathieson Alkali Works), died on July 24 after a brief illness. He was forty-six years old.

Mr. Dolan was born in Cleveland, Ohio, and attended grammar and high schools in that city. He was graduated from Western Reserve University in 1928. After joining Mathieson as a salesman in 1930, Dolan became Manager of carbon dioxide sales in the following year and in 1935 was made Assistant General Manager of Sales. He became Assistant to the President of the firm in 1937, and the following year was named Vice-President. In 1940 Mr. Dolan was chosen Executive Vice-President and on January 1, 1944, became President of the company. In April, 1948, he was named Chairman of the Board.

✝**Fred J. Henning,** Field Sales Representative of the Philadelphia Quartz Company, Philadelphia, Pa., died July 9, 1948, at Oak Park, Ill., after a brief illness. He was forty-five years old. Mr. Henning received his Bachelor of Science degree in Chemical Engineering at the Tri-State College, Angola, Ind. Prior to his association with Philadelphia Quartz Company he had been chemical engineer with Westinghouse Lamp Company, Bloomfield, N. J., and Western Electric Company, Chicago, Ill.

In 1930 he joined the Philadelphia Quartz Company as a sales representative with headquarters at the Company's Chicago Sales Office. One of his initial assignments was the introduction of the firm's Metso sodium metasilicate to the trade in the Midwest territory. He also contributed to the technical literature on the uses of metasilicate and other silicates in industry.

Mr. Henning is survived by his wife, Ava Lou Henning, and four children.

✝**Harry Diamond,** Chief of the Electronics Division of the National Bureau of Standards, died suddenly at his Washington home on June 21, 1948.

Mr. Diamond was born on February 12, 1900 and attended schools in and around Quincy and Boston, Mass. He received his Bachelor of Science degree from the Massachusetts Institute of Technology in 1922, where he served in the S. A. T. C. during World War I, and took his master's degree in electrical engineering from Lehigh University in 1925.

After Mr. Diamond joined the staff of the National Bureau of Standards as a radio engineer in 1927, his brilliant scientific achievements led to rapid advancement. He was Chief of the Bureau's Ordnance Development Division during the war, and later of the Electronics Division, which now includes the ordnance work. During the five years between graduation from M. I. T. and entry on the Bureau staff, he was at first employed by various industrial concerns in the Boston area and later taught for four years at Lehigh University, where he organized the first radio course at the University.

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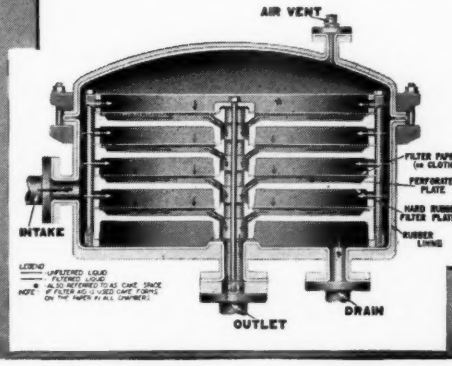

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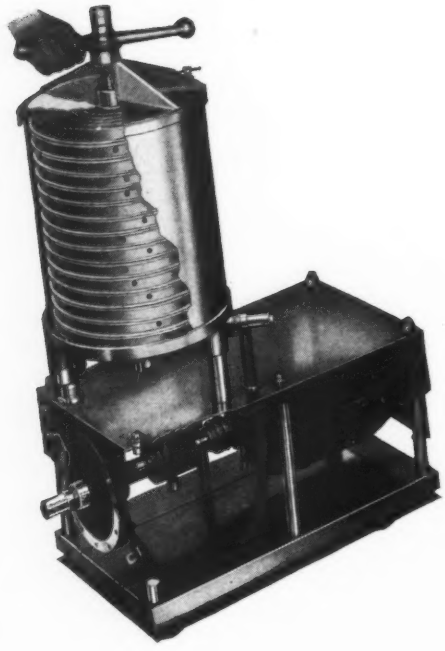

Inside Story

of the positive, trouble-free

"Sealed-Disc" Filter

for plating solutions

The last word in SIMPLICITY *and* ALL 'ROUND EFFICIENCY

Here's What It Does For You

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This look inside the "*Sealed-Disc*" Filter tells the story of the new filtration principle which is responsible for the enormous filtration area and great capacity in such a small compact unit. This is why "Sealed-Disc" Filters are capable of handling as large a volume of solution as conventional filters many times their size.

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Filter assembly showing individual parts

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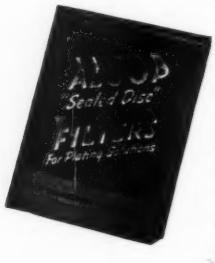

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Editorial

September 1948

BASIC RESEARCH IN ELECTROPLATING

ONE ENCOURAGING SIGN of the times, recently voiced by Gardam and Hothersall in England, is the beginning recognition that electrochemical theory has been "inadequate" and "unfruitful" in promoting electroplating development. With few exceptions research workers in electroplating seem to have passed by all the modern electronic theory. When they theorize, and they do it very seldom, they still think in terms of the old electrochemistry of Arrhenius which, based as it is on thermodynamics, throws no light on, in fact, does not concern the mechanism of the process.

In electroplating we deal with properties of plating solutions and of deposited metal. Both electrolytes and metals have received attention by the atomic physicist. The English in particular have been rather successful in explaining the mechanism of many metallurgical phenomena, electric conduction of solids, formation of solid solutions and intermediate phases of some alloy systems, and the like.

But electroplating is really the process that takes place at the interface of plating solution and metal, first base metal and then deposit. We have today very little understanding of what actually happens in this region as witnessed by our dim views of polarization and overvoltage and our lack of comprehension of the whys and wherefores of mechanical properties of and stress in deposits.

Electroplating, therefore, is wide open for basic research. It is hoped that young men skilled in atomic theory will receive encouragement to enter the plating field and give it a surer theoretical foundation and that those who now work in it will study and learn to think in terms of already existing theory. By these means we may, as was so well expressed by Dubpernell a few months ago in this journal, "expect to see many further remarkable new plating and finishing processes which are yet not even foreseen for the most part."

Gustaf Soderberg

Notes on FILTRATION in a modern plating plant

G. M. COLE

Process Engineering and Laboratories, Detroit Plant
Fisher Body-Ternstedt Division, General Motors Corporation

THE filter has become a standard piece of equipment in the modern plating plant. In the past few years it has graduated from the status of an "emergency tool" to one of importance almost equal to that of the generator and the automatic conveyor. It is no longer an afterthought but is designed into the original plant layout.

As the demands for better quality and higher production rates have risen, the filter, along with other types of plating equipment, has developed in design and efficiency. The manufacturers of filtration equipment, the engineers and the platers are to be commended for the improvements they have wrought in the design of filtration systems in the interests of better plating. All three will be quick to agree that additional improvements may be expected in the future as the need for them arises. The manufacturer of the equipment and the engineer responsible for the layout of the filtration system can be counted on for assistance in meeting any new requirements or specification which may be considered necessary, but only the plater can determine and define what these requirements and specifications are to be.

This discussion does not pretend to treat the subject of filtration exhaustively. It is only an attempt to illustrate some of the features of filtration in common practice today and some of the trends of thought toward the practice of the future.

The Filtration System

Fig. 1 is a schematic drawing of a modern filtration system. It is shown to illustrate the complexity of the newer systems and how they are being combined with the solution heating system as well as with a means of adding materials to the plating solution.

The engineer will expand the schematic drawing into several blue prints which will contain specifications for every pump, pipe-line, valve and bolt to be used and show just where it is to go. This is considerable progress from the day when the little portable was rolled out from its corner for emergencies or week-end treatments.

The main purposes of the particular arrangement in Fig. 1, which was designed for a 10,000 gallon bright nickel plating tank, are (a) to circulate 144 gallons of nickel plating solution per minute through the plating tank by means of two balanced and independent systems, (b) to maintain a solution temperature of 140° F, (c) to filter the solution in each system at the rate of 42 gallons per minute, (d) to remove impurities in an electropurification tank with a circulation rate of 45 gallons per minute and, (e) to provide a means of transferring the solution to and from storage tanks. This is accomplished with a balanced dual pump arrangement including (a) circulating pumps rated 71 gallons per minute at 120 ft head, with 7½ hp motors, (b) a bank of three heat exchangers per system, and (c) one Porostone filter per system rated at 71 gallons per minute when clean.

In laying out such a system the engineer is not guessing the pipe and valve sizes nor the pump and motor sizes. He is well posted on the materials to be used. However, he must come to the plater for two important pieces of information, namely, the rate of filtration and the type of filter to be used. At present, the plater must draw on experience alone for his answers.

The Filter

Naturally, the heart of any filtration system is the filter itself, and since the approach here is from the practical viewpoint, it seems apropos to discuss it in some detail. It was assumed that the system illustrated was to serve the 10,000-gallon bright nickel solution set forth above and that the desired rate of filtration was 5,000 gallons per hour. The manufacturers of filters suitable for plating were approached and asked if they would supply authentic detail for a filter that would meet the requirements of this hypothetical installation. Their response was overwhelming, and the illustrations in Figs. 2 to 8 are authentic reproductions showing the structural features of most of the familiar makes of filters available to the plater today. The only comment that need be made here is that despite the variations in structural details, all of the designs make use of the same principles of separation and, therefore, all of them have three basic features in common, namely, a pressure chamber, a filtering medium or a support for same, and a collection chamber which is sometimes a series of channels.

There are, of course, many other makes and types of filters, not all of which meet the plater's special requirements, and there are several of interest to him which are not illustrated because of lack of authentic material. It seems safe to conclude that if the plater makes good use of such equipment, the clarity of his solutions can be whatever he desires.

The Filtration

After the engineer and the filter manufacturer have completed their part, the plater takes over and the operations begin. In order to get, first hand, the plat-

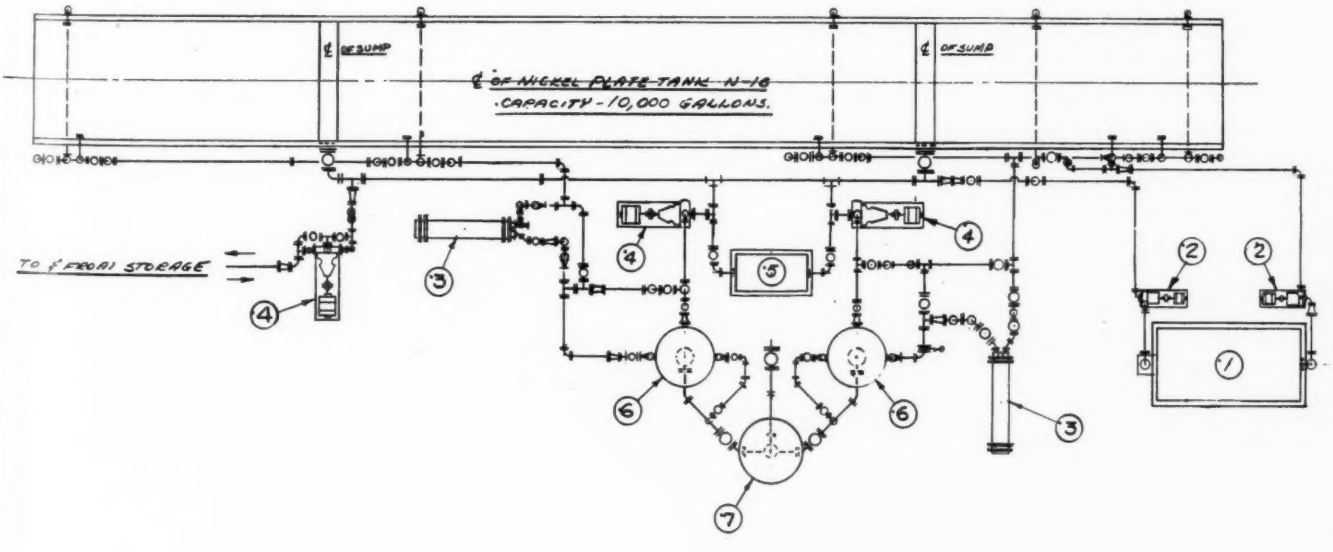

Fig. 1. Schematic drawing of modern filtration system. (1) Tank for continuous electrolytic purification, (2) pumps for same, (3) heat exchangers, (4) pumps, (5) tank for making salt additions to solution or slurry for filters, (6) filters, (7) filter clean-out tank

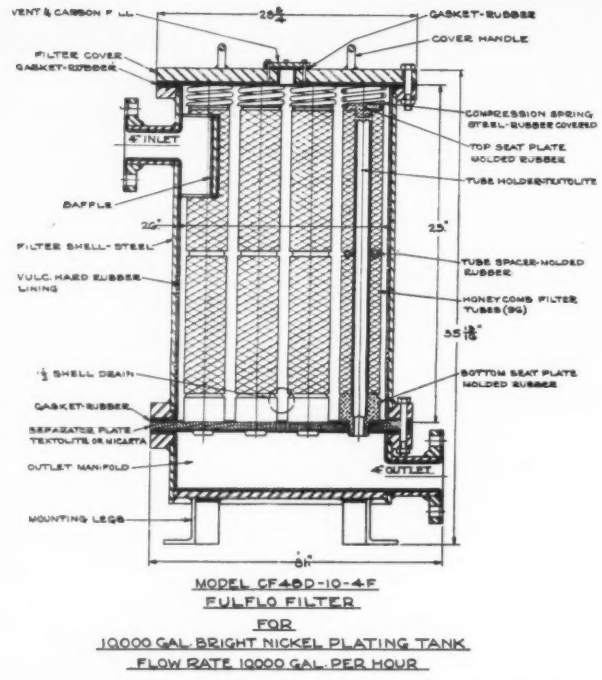

Fig. 2. Cross section of Model CF48D-10-4F Fulflo Filter manufactured by Commercial Filters Corporation. Stated flow rate, 10,000 gal/hr

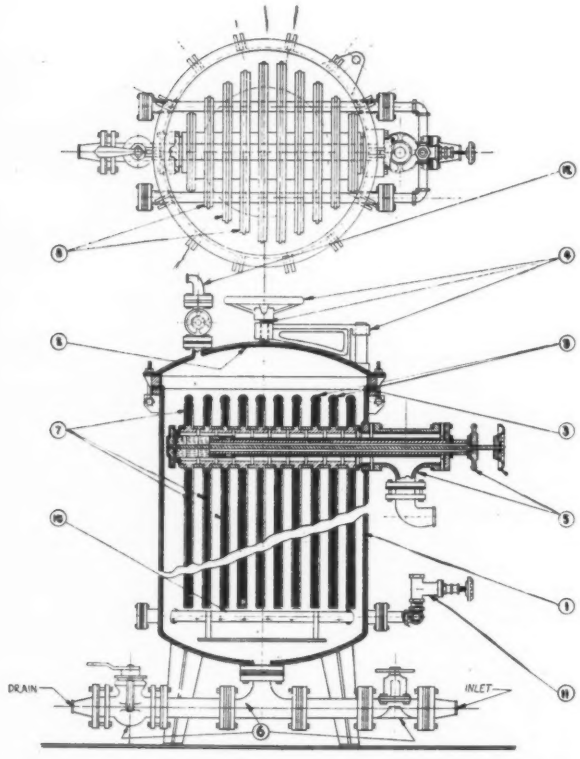

Fig. 3. Cross sections of Type RDR, Model 3 Industrial Filter manufactured by Industrial Filter & Pump Mfg. Co. (1) Rubber-lined filter tank of welded steel, (2) rubber-lined, steel cover, (3) tubular rubber gasket, (4) cover lifting device, (5) rubber-covered lock-up assembly and outlet manifold, (6) filter inlet and drain assembly, (7) molded hard-rubber filter baffles, (8) nylon filter bags, (9) hard-rubber sealing clips for filter bags, (10) air-wash manifold and support for filter baffle, (11) air inlet valve, (12) air relief valve

er's viewpoint on filtration as it is performed daily in his plant, a questionnaire was sent to eighteen large operators, all of whom are either directly or indirectly connected with the automotive industry.

Question 1: Is adequate filtration a problem in your operations? *Answers:* Yes—62 per cent; No—38 per cent.

Question 2: Do you filter your plating solutions continuously or periodically? *Answers:* Continuously—75 per cent; Periodically (only)—None; Both—25 per cent.

Another way of stating the answers is that everyone recognizes the need for continuous filtration and that 25 per cent want, in addition, a thorough clean-up periodically.

Question 3: What rates of filtration are you using at present in terms of "turnover" time, i. e., hours per tank volume? *Answers:* Less than one hour—None; 1 to 2 hours—Six; 2 to 4 hours—Six; More than 4 hours—Three.

Fastest rate mentioned was one turnover per hour, slowest rate one turnover in ten hours.

Question 4: What rate of filtration do you consider satisfactory in terms of turnover time? *Answers:* Less than one hour—Four; 1 to 2 hours—Six; 2 to 4 hours—Four; More than 4 hours—One.

Taken together, the answers given to the last two questions would seem to indicate that the trend is definitely toward higher rates of filtration. Although none of the questions differentiated between copper and nickel plating solutions, the responses frequently did; as will be brought out later, the copper plating solutions with their unbagged anodes appear to account for the trend to higher rates rather than the nickel solutions with their bagged anodes.

Since the rate of filtration is such a basic factor, it warrants some elucidation and discussion. When the filtered solution is being returned to the plating tank, it continually lowers its dirt content but never removes it completely. This can be seen from the following equation:

$$T = -2.3 \frac{V}{R} \log_{10} \frac{c_2}{c_1}$$

When T = time in hours
V = tank volume in gallons
R = filtration rate in gallons per hour
c_1 = initial content of contaminant
c_2 = contaminant content after T hours

It is seen that $p = 100\ c_2/c_1$ is the per cent contaminant remaining after T hours of filtration. One can also write $t = V/R$ where t is the rate of turnover in hours per tank volume. Hence the equation can be simplified to

$$T = -2.3\ t \log_{10} \frac{p}{100}$$

This equation has been plotted in Fig. 9 for five values of t, namely 10, 4, 2, 1⅓, and 1 hour. For a

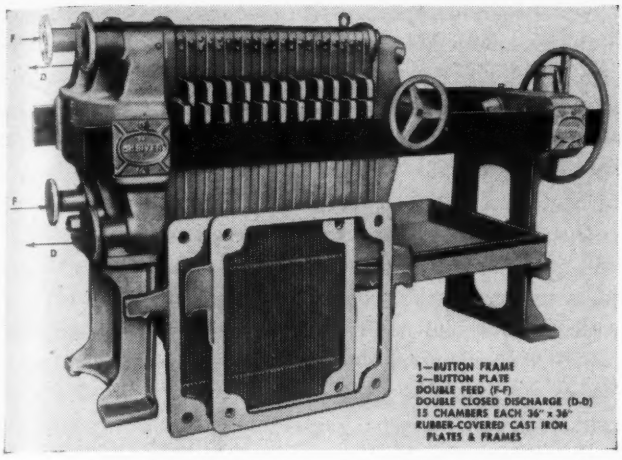

Fig. 4. Type 40S Shriver Filter manufactured by T. Shriver & Company

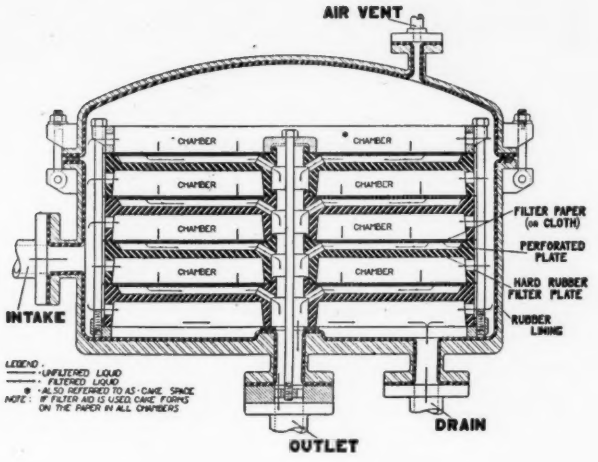

Fig. 5. Cross section of Sparkler Horizontal Plate Filter manufactured by Sparkler Manufacturing Company. Rubber construction

1000 gallon solution (V = 1000), these t values are equivalent to filtration rates of 100, 250, 500, 750, and 1000 gallons per hour.

It should be noted, that the development of these simple equations required three assumptions, namely, that (1) the returned portion of clarified solution mixes completely and instantly with the solution in the tank, (2) the rate of solids removal by the filter remains constant, (3) the rate of pollution is zero. None of these conditions ever actually exist. If the rate of 500 gallons per hour is used for a 1000 gallon tank the curve corresponding to this rate (t = 2) indicates that it will take over 9 hours for the filtration system to reduce the solid content to 1 per cent of its original value. If the plate is useful, with a 10 per cent of the original solids content, then only a little over 4½ hours of filtration will be required before operations can be resumed. Actually, the size of the filtration system would enable it to remove all solids in two hours if the filtrate were being delivered to a storage tank; the practice of mixing the filtrate with dirty solution places the additional load on the system.

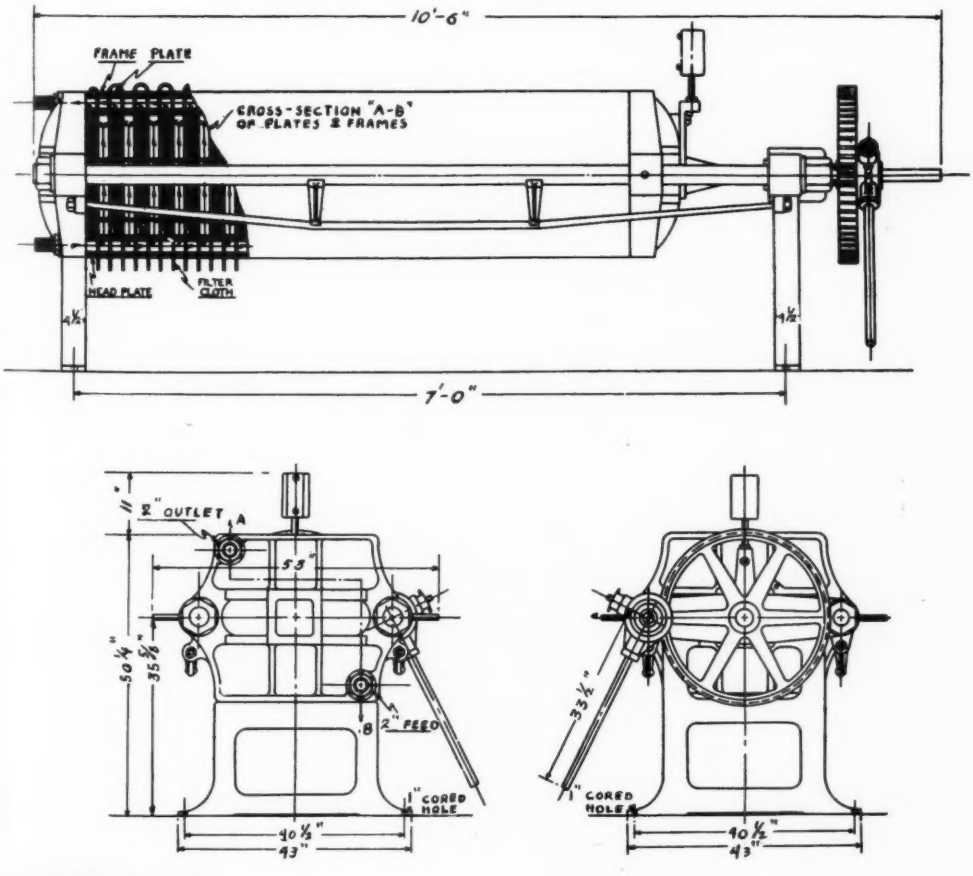

Fig. 6. Views of a 30-inch Type RGC Sperry Filter Press manufactured by D. R. Sperry & Company. Rachet gear closing device; closed delivery; non-washing; parallel surface plates with 24 1-inch thick chambers of rubber-covered iron, 2 head plates, 23 plates, and 24 frames

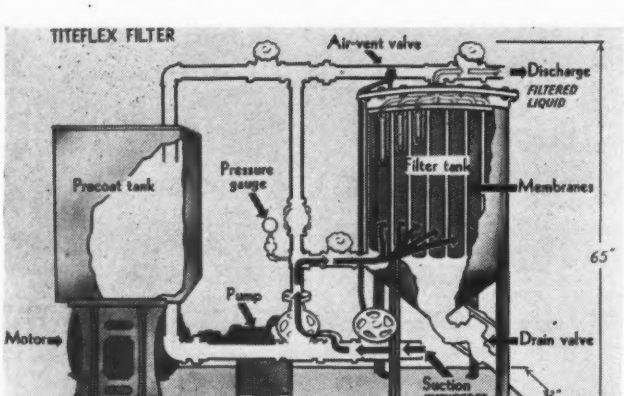

Fig. 7. Cut-away view of Titeflex Filter manufactured by Titeflex, Inc.

Putting it another way, the nominal rate is one turnover in two hours (practically, a fast rate), but the actual rate one in about 9 hours.

Question 5: Aside from cost differences, do you favor any one make of filter over the others that are available? *Answers:* Yes—80 per cent; No—20 per cent.

These answers should not be construed to mean that one manufacturer has an 80 per cent monopoly on the filter business; on the contrary, it appears that nearly all filters are considered tops in one quarter or another.

Question 6: If your answer to question 5 is "yes", will you list some of the features that you like about this filter? *Answers:* Quick and easy cleaning—82 per cent; Large filter area—55 per cent; Low maintenance costs—45 per cent; Non-leaking characteristics—2 per cent; Efficiency of dirt removal—18 per cent; Permits use of filter paper—18 per cent.

The surprisingly low percentage of respondents who mentioned "Efficiency of dirt removal" is probably explained if it is allowed that those failing to mention it took this feature for granted.

Question 7: Would you list the chief sources of "dirt" which you remove by filtration? *Answers:* Anodes—93 per cent; Air-borne solids—75 per cent; Work-borne solids—60 per cent; Precipitates (organic, hard water, iron, filter-aid)—33 per cent; Rack insulation—13 per cent.

The figures do not quite give an accurate picture of the answers to this question inasmuch as most respondents consider the copper anode a much greater offender than the bagged nickel anode. There was originally another part to this question asking for an estimate of the percentage of the total dirt that each source contributed. So few would attempt to make the estimate that this portion of the question was dropped.

Question 8: Are you able to remove all of the dirt with your present filter? *Answers:* Yes—50 per cent; No—40 per cent; Yes for nickel solutions, No for copper solutions—5 per cent; Don't know—5 per cent.

Question 9: Do you use anode bags? *Answers:* Yes—100 per cent; No—None.

All but one operator use bags on nickel anodes, a few on copper anodes. It is significant that the filtration system is not trusted to maintain the clarity of the solution but that the anode behavior requires a further control in the form of anode bags.

Question 10: If your answer to question 8 is "no", will you suggest improvements that might effect complete dirt removal? *Answers:* Careful location of multiple intakes—20 per cent; Design for complete filtration—20 per cent; Faster circulation—13 per cent; Finer medium—13 per cent; No suggestion—41 per cent.

The replies to this question were not as definite and clear as those given to the other questions, and there is a discrepancy between the answers to question 4 which indicated a strong tendency toward faster filtration rates and the 13 per cent who mentioned it in their answers to this question.

New Approaches

Elimination of the dirt originating on copper anodes and to a lesser extent on nickel anodes has been shown to be one of the difficult problems still confronting the plating room operator. A relatively new approach to this problem is to divide the plating tank into separate anode and cathode compartments. Figs. 10 and 11 illustrate two such means for accomplishing complete filtration and at the same time eliminating the troublesome but so far indispensable anode bag. Fig. 10 is taken from a proposal by Phillips and Clifton wherein the dirt-producing anodes are separated from the work by a cloth membrane supported by a suitable frame*. All solution that has come in contact

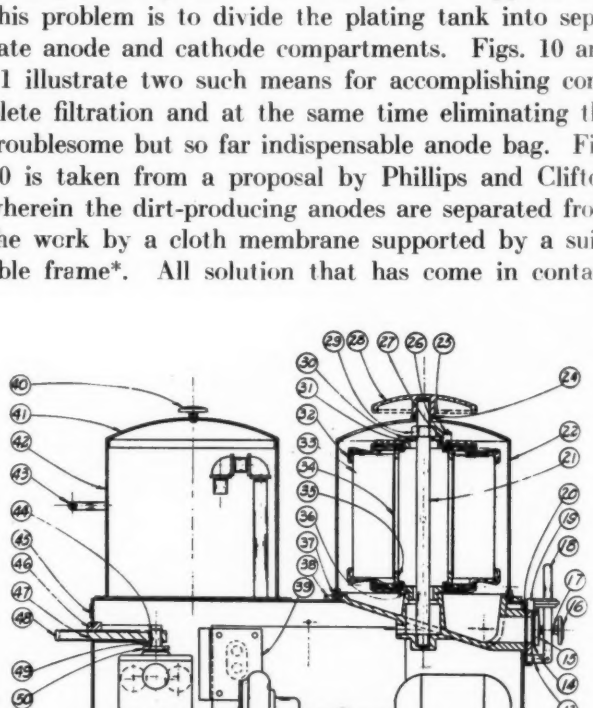

Fig. 8. Cross section of Udylite Automatic filter manufactured by The Udylite Corporation. Capacity 500 gal/hr

*See also the paper, "Diaphragm Tanks To Eliminate Roughness in Copper Plating", by R. H. McCahan and C. E. MacKinnon to be published in Vol. 35 of Proc. Am. Electroplaters' Soc. (1948).

with the anodes is filtered before it is permitted into the work compartment. This is quite different from general practice of placing the work, which should be as free of dirt as possible, as close as possible to the anode, the chief source of dirt, and the filtration system off to one side in a kind of parallel arrangement where it competes with the work to see which gets to the dirt first. Naturally, being much the closest, the work usually wins and one must resort to a handicap like the anode bag in order to give the filtration system a chance.

In these proposals the filtration system is, in effect, placed directly between the dirty anode and the work which it is intended to protect. The membrane of porous stone in Fig. 11 gives rigidity and permanence to the structure.

It is nowise claimed that the technique of working with such constructions is fully developed; they are, however, of considerable interest because they give our new highly refined filtration systems an opportunity to accomplish all that they are capable of in maintaining a "dirt-free" solution.

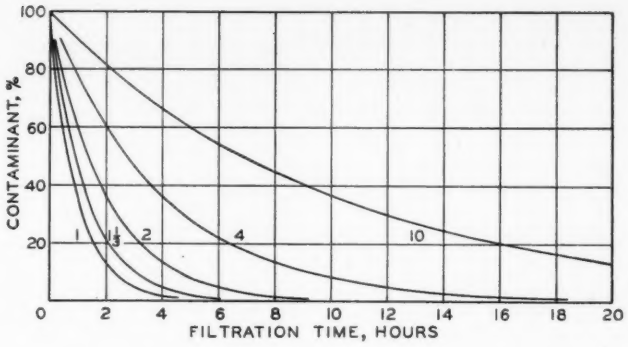

Fig. 9. Per cent remaining contaminant vs. filtration time in hours at indicated turnover rates (t) in hours per tank volume. Perfect and instantaneous mixing, constant rate of solids removal, and zero rate of pollution assumed

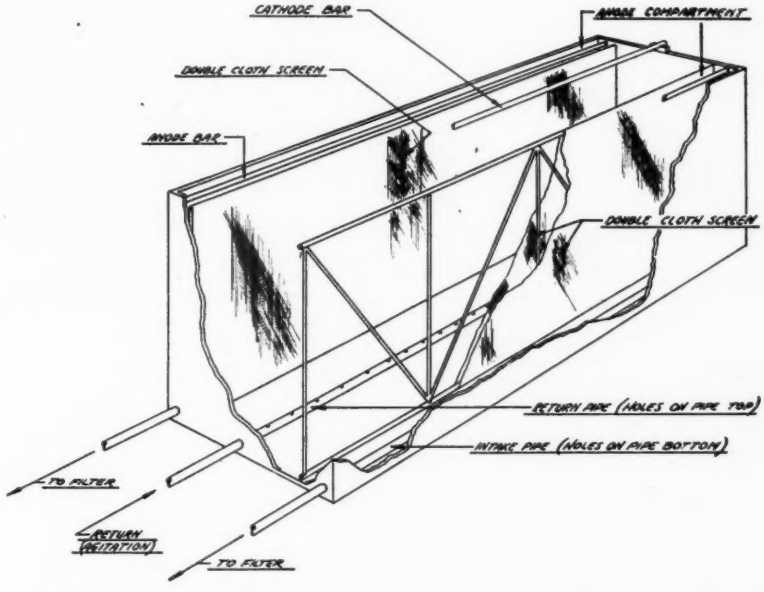

Fig. 10. Cloth diaphragm arrangement for separating anode and work compartments proposed by Phillips and Clifton

Unsolved Problems

It is hoped that this rather sketchy treatment of an important subject will lead to further study and clarification of thought. Our present knowledge needs consolidation and integration into more standardized practice. A number of pertinent questions are being asked to which we do not yet have satisfactory answers. Examples are: "What is the optimum clarity of plating solutions for which one should strive?"; "Should filters be purchased on performance standards as is frequently done in the drug, brewing, perfume and many other industries?"; "Is it justified to seek faster filtration rates and hence higher budgeted installations?"

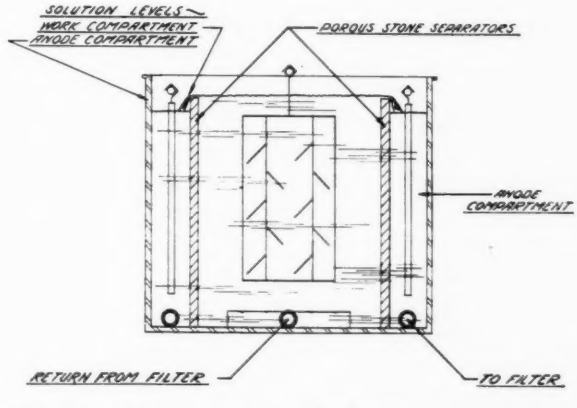

Fig. 11. Porous stone diaphragm arrangement for separating anode and work compartments

Acknowledgment

Without the contributions and assistance of those named below much of the information given above could not have been obtained. Grateful acknowledgment is made to R. Ackerman, R. P. Adams Company, Alsop Engineering Company, M. M. Beckwith, M. Caldwell, F. Clifton, Commercial Filters Corporation, J. T. Crittenden, Electric Autolite Division, T. J. Fadgen, S. M. Gastron, A. Granik, Industrial Filter & Pump Manufacturing Company, J. H. Lindsay, G. L. Nankervis, F. R. Nethaway, C. F. Nixon, D. Overcash, Malcolm Phillips, W. M. Phillips, W. L. Pinner, T. Shriver & Company, Sparkler Manufacturing Company, D. R. Sperry & Company, E. Stadel, The Standard Steel Spring Corporation, Titeflex, Inc., The Udylite Corporation, R. M. Wagner, and A. B. Wilson.

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Louis M. Hague

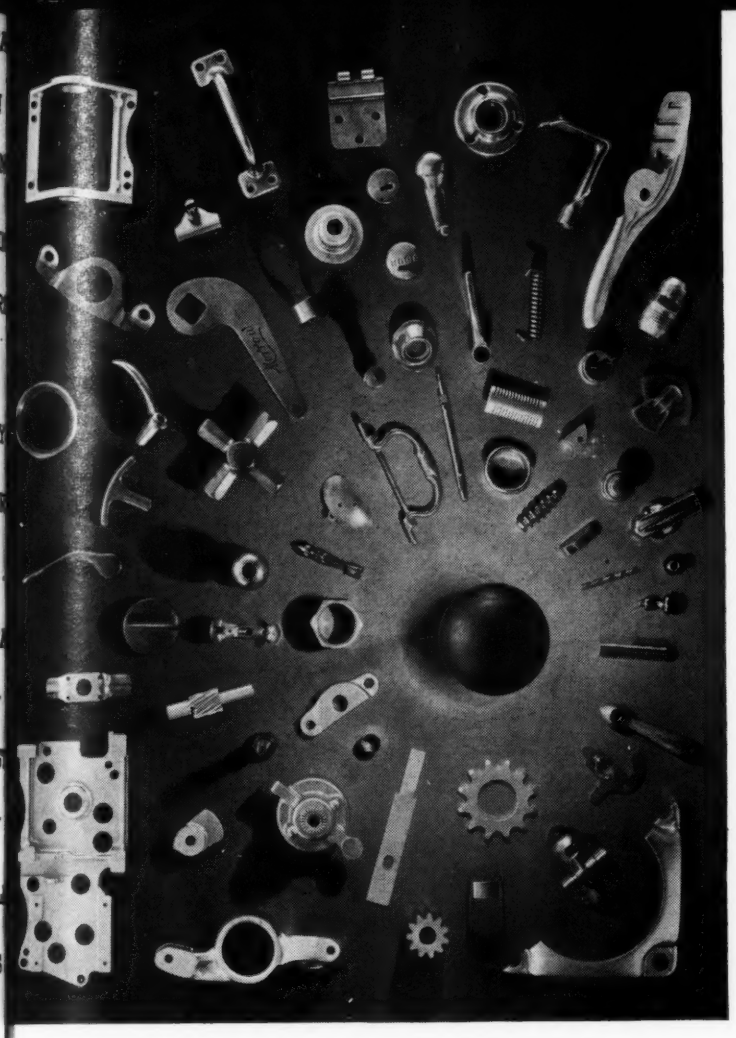
LOUIS M. HAGUE, recently elected President of Hanson-Van Winkle-Munning Company, Matawan, N. J., is a guiding spirit of the oldest and one of the largest suppliers in the electroplating, hot dip galvanizing, and allied fields.

Born and brought up in Pittsburgh, Pa., where both his father and grandfather before him operated electroplating plants, Hague received his early education in Shady Side Academy, Pittsburgh, Pa. A member of the Class of 1917, he participated in World War I as an infantryman, eventually retiring from the Reserve Corps as Captain. At the war's end, he returned to school and graduated from Lafayette College in 1923 with an A.B. degree. Hague is a former member of the Alumni Council of Lafayette, the Alumni Member of the Athletic Committee, a member of the Visiting and Advisory Committees, and Past President of both the Alumni Associations of Western Pennsylvania and the New Jersey Shore.

Hague has followed in the footsteps of his forebears and has spent his whole working life in the metal industries, particularly the plating industry. He joined the staff of the Hanson-Van Winkle-Munning Company in 1928, one year after its formation by merger of The Hanson and Van Winkle Company and the A. P. Munning & Company. Here he has served in various capacities in both sales and service, taking on increasingly heavier responsibilities. In 1939 he became Vice-President and was elected a Director.

Outside of his business, Hague has taken a lively interest in civic matters and in the welfare of his community, the Borough of Rumson, N. J. A former President of the Rumson Republican Club, he served as Councilman and Police Commissioner in 1938-1940, Councilman again in 1942, and Mayor in 1943-1947. Hague was also at one time President of the Board of Trustees of the Police Pension Fund Commission and a member of the Planning Board of Rumson. He is a member of a number of clubs: Rumson Country Club, Seabright Beach Club (of which he is President and Chairman of the Board of Governors), Sea Bright Lawn Tennis and Cricket Club, The Leash (New York City), and the University Club of Cleveland, Ohio. He is a life member of several fraternal organizations: Crescent Lodge 576, F. & A. M. (Pittsburgh), Ancient Accepted Scottish Rite and Crescent Temple, A. A. O. N. M. S. (Trenton, N. J.). His college fraternity is Phi Kappa Psi.

Although Hague's prime contribution to the plating industry has been that of business management, he has always been interested in technical matters and has appreciated the value of research. He is a member of he American Electroplaters' Society and has always given it his firm support. He is currently President of the International Fellowship Club, the organization of the supply houses in the plating industry which has made it a special task to entertain the A. E. S. convention vistros.



Parts finished by Roto-Finish technique

MECHANICAL FINISHING WITH ROTO-FINISH TECHNIQUES

ARTHUR P. SCHULZE

Lakewood, Ohio

WITH MATERIALS and labor cost curves continuing to climb, it has become increasingly essential that manufacturers reexamine and reappraise their major production operations with a more critical eye than ever before. In their determined search for any practical means to offset these higher costs, many producers are thoroughly investigating the utilization of materials as well as methods and machines designed to save time or to step up the productivity of the workman.

It is from this standpoint primarily that certain relatively recent developments in barrel finishing continue to draw attention wherever finishing parts by mechanical means preparatory to electroplating constitutes an essential operation. Keen interest is currently being shown in these processes also because of their extensive range of application, plus certain advantages from the quality standpoint.

In the following article are reviewed the particular characteristics of the Roto-Finish techniques developed by the Sturgis Products Company, Sturgis, Mich. A recapitulation of results illustrating the sizable savings now being obtained where this mechanical method is being employed is also included.

Applicability

Basically a tumbling routine employing wet mixtures of specially developed chips and compound, this technique provides high flexibility in finishing ferrous and non-ferrous metals and alloys. Iron, steel, stainless steel, brass, aluminum, magnesium, copper and zinc alloys, in the form of stampings, forgings, extrusions, machined parts, or die castings, from the tiniest pieces weighing but a mere fraction of an ounce to intricately shaped parts weighing as much as 75 pounds apiece, all are handled with equal effectiveness and facility.

Four basic types of operations are performed, namely (1) grinding and deburring, (2) polishing, (3) bright-honing, and (4) coloring.

Advantages

A number of advantages are seen from the use of these techniques, whatever the particular operation may be:

(1) Parts can in some instances be finished on a quantity basis in one operation and in a fraction of the time associated with manual methods. By staggering schedules, one operator can load and unload a

battery of machines. Use of hoist pans and other time-saving, labor-conserving accessories increases output and decreases downtime.

(2) High uniformity on a continually repetitive scale permits standards to be established to secure the same required finish on every piece. Being under control, the process may be regulated from severe cutting to fine finishing. As a result, critical and close tolerance specifications can be maintained accurately and uniformly.

(3) Substantial finishing economies can be made directly. Costs are reduced on the average by from 35 to 60 per cent and frequently more. With hand labor eliminated, slow-downs are reduced to a minimum, assuring a steadier flow of work. Timing of processing schedules may be estimated with greater accuracy than often possible otherwise.

(4) Hand-finishing operations (hand deburring, wheel grinding, polishing, and buffing) having been eliminated, skilled labor can be transferred to other vital work.

Cost Data

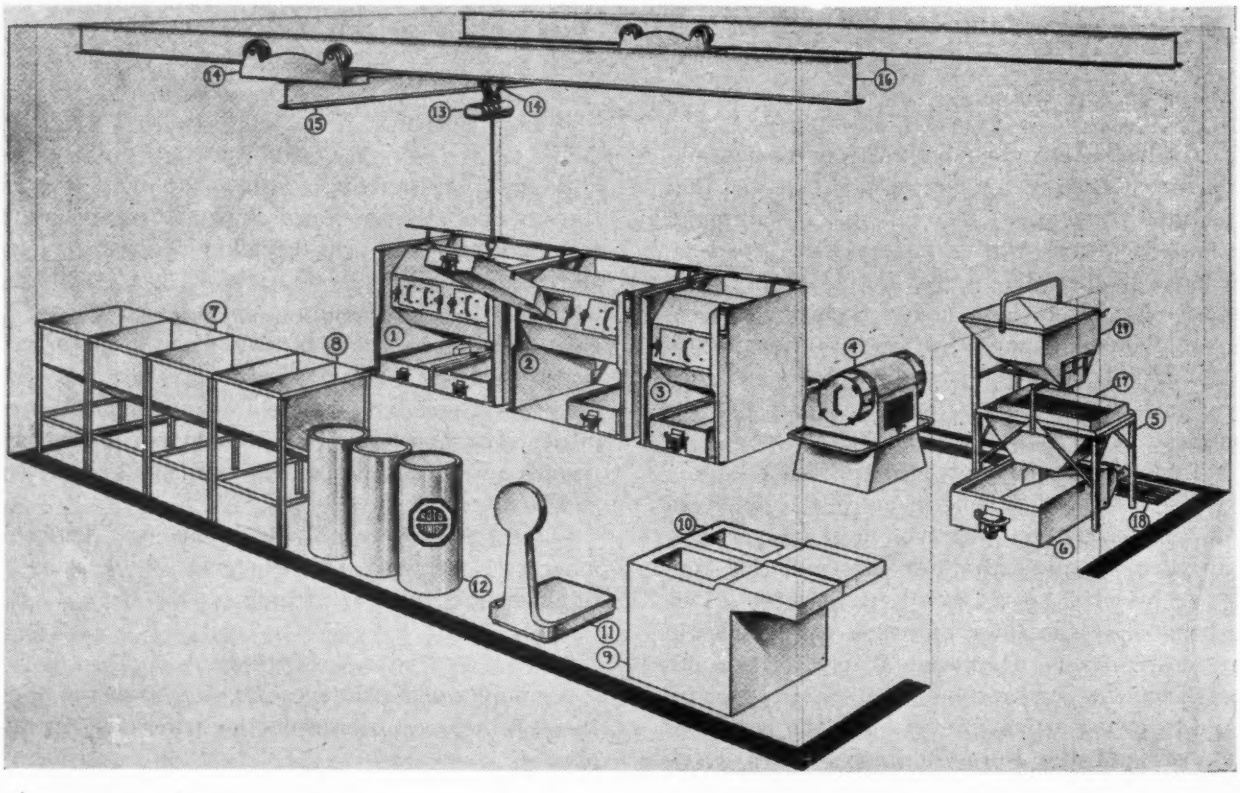
In a large die casting finishing plant in which production totals approximately 70 tons of die castings daily, the use of the process is averaging a cost saving of 50 per cent compared to former hand deburring with files and "hand-held" polishing and buffing routines. The labor savings effected are especially noticeable in finishing the small die castings, most of which have irregular contours, short radii, and relatively inaccessible internal surfaces. In addition, the finish produced is equal—and frequently superior—to that previously secured. Surface finishes are now more uniform; dimensional loss is controlled far more easily and accurately.

Another example of production economies is the experience of a medium-size maker of automative parts and plumbing hardware who uses this process to grind, buff, deburr, polish, or hone small die castings and small stampings. Here, handling six units simultaneously, a single operator deburrs an average of 12,000 pieces in five hours. Considerable savings have been realized, especially in the substitution of the Roto-Finish Process for buffing; for example, the cost of buffing a small part was reduced from $14.40 to $5.00 a thousand pieces.

Another plant reported that savings in labor alone effected by Roto-Finish bright-honing over wheel buffing of stampings, die castings, screw machine products and other parts run from 9 per cent all the way up to 97 per cent.

Processing Time

Production experience of numerous plants shows the processing time to fall within the following limits: deburring, from 15 minutes to 10 or 12 hours; grinding, from 8 to 48 hours; polishing, from 15 minutes to



Model Roto-Finish department. (1) to (4) Machines, (5) manual separating table, (6) hoist pan, (7) and (8) chip bins, (9) rinse tank, (10) rust prevention oil tank, (11) weighing scale, (12) compounds, (13) hoist, (14) to (16), bridge crane arrangement, (17) screen for separation, (18) drain, (19) hopper.

View of Roto-Finish department

16 hours; bright-honing, from 1 to 3 hours; and coloring, from 15 minutes to 2 or 3 hours. The average time required to deburr machined or stamped steel, brass, or aluminum parts is from 1 to 4 hours, and the average time to finish a zinc base die casting prior to electrodeposition of copper, bright nickel, and chromium is 6 to 8 hours.

A recent precision barrelling installation for deburring and rounding off corners of automatic washing machine parts of wide diversity in size and shape is being operated with the following processing time periods: Average time for processing gray iron sand castings, 1 to 2 hours; steel stampings, 1½ to 3 hours; aluminum die castings, 2½ hours.

Mechanics of the Method

Attention will now be turned to the mechanics of the method. Each basic type of mechanical finishing performed by this process will be examined, and brief analysis will be made of the materials, compounds, and equipment required for grinding and deburring, polishing, bright-honing and coloring.

Deburring

For years one of the metalworking industry's biggest bottlenecks and costliest operations has been deburring. For the most part, this has consisted of hand-finishing literally billions of parts either on polishing and buffing wheels or with files, scrapers, flexib e shaft grinders or wire-brush wheels. Because these operations are both tedious and time-consuming, it is obvious that any method which can expedite them while producing comparable quality finishes on a quantity basis also can be expected to effect substantial manufacturing economies.

Such a process is Roto-Finish grinding and deburring, in which the work is wet tumbled in specified mixtures combining specially sized and prepared minera chips and certain carefully formulated and selected mixtures, so called compounds.

The operation is performed in octagonal-shaped, wood-lined barrels of the single or multiple compartment type, made in four different sizes ranging in compartment size from 27 x 32 inch to 8 x 12 inch I. D. The horizontal cylinder is mounted on ball bearings, driven by an electric motor and optionally equipped with a variable speed drive and automatic timer. A removable backplate enables the wood lining to be taken out from a compartment when no longer usable and new replacement lining to be installed easily by any competent maintenance man. Compartment doors, too, are similarly adaptable for relining.

Table I presents average figures on compartment sizes of the various machines. Recommended workloads in each model for grinding or deburring different metals are given in Table II.

Even though the work is carried out in tumbling barrels, as equipment of this general type is com-

TABLE I. CAPACITY OF ROTO-FINISHING MACHINES

Machines Model No.	No. of Compartments	Compartment		
		Size inch	Capacity cu. ft	Chip Mass lb
CW-60-2	2	27 x 32	13½	700
CW-45-2	2	19½ x 32	9½	500
CW-22-1	1	19½ x 32	9½	500
AMV-1	2	8 x 12	½	25

TABLE II. APPROXIMATE WORK LOADS PER COMPARTMENT IN WET GRINDING AND DEBURRING

Machine Model No.	Steel,	Brass	Aluminum Magnesium	
	lb	cu.ft	lb	cu.ft
CW-60-2	140	1.4	80	0.8
CW-45-2	100	1	60	0.67
CW-22-1	100	1	60	0.67
AMV-1	5	–	3	–

monly called, the method, strictly speaking, cannot be called a tumbling process by virtue of the fact that it avoids the impacts typical of most tumbling routines. Parts are not carried to the top of the processing cylinder and dropped against other pieces of the load; instead, they remain immersed in the mixture. Since the work included in the mass rises but a few degrees due to the low rpm of the octagonal barrel, parts are not thrown about and hence there are no impacts between them.

Rate of cylinder rotation is varied depending on the size and shape of the part to be treated as well as the degree of deburring desired. Processing time varies accordingly. The cycles set forth in Table III have proven suitable as determined by extensive tests and experiments.

TABLE III. PROCESSING TIME FOR GRINDING VARIOUS BASE METALS AND PARTS

Metal Treated	Processing Time, hr
Aluminum stampings and die castings	1/6 - 8
Brass, machined	1/4 - 8
Brass sand and die castings	3 - 24
Steel stampings and machined parts	1/4 - 12
Iron and steel castings and forgings	5 - 24

Other processing variables are size and type of grinding chips and composition of compound. Since it is not a simple matter to predict the exact size of chip, type of compound, quantity of parts per charge, and cycle period best suited to produce optimum results at minimum cost in any given instance, an experimental sample processing department is being maintained for running tests, under operating conditions closely simulating those prevailing in the prospective user's plant, to find the answers to these problems. Once determined for a given part, the processing sequences that evolve from these tests insure duplication of the desired results in full-scale operation.

The action of the grinding chips on the work within the machine provides the key to the finish ultimately attained. Carefully presized and prepared, they are available in 17 different sizes, ranging from 1¾ inch in longest dimension down to 1/16 inch and are identified by number from 1 for the largest through 17 for the smallest.

The size of part and the dimensions of any holes or recesses govern the size chips employed. Chips of such size must be used that they do not wedge in any openings that the piece may have. Furthermore, large chips cut faster than the small ones and produce a rougher finish.

To reduce processing time and turn out a superior finish at the same time, use of large and small chips in predetermined combination is a fast-growing trend today, especially for deburring small slots and recesses in many types of steel stampings. The smaller chips generally flow through such openings without wedging.

A combination of small chips is frequently suggested for treating unhardened steel parts on which a low-microinch surface finish reading is wanted. Somewhat larger chips are recommended for hardened work. General experience shows it possible to bring a 60–40 microinch surface finish to 30–25 microinches with grinding chips and from 10 to 10–5 microinches with bright-honing chips.

Use of compounds along with chips and water comprises an important factor in wet grinding and deburring operations. Consisting of materials of varied alkalinity and abrasive content, these compounds serve six essential functions: (1) lubricate both chips and parts; (2) prevent tarnishing, etching, or rusting; (3) help keep compartment and chip mass clean; (4) in some cases, provide the amount of abrasive action required to produce the desired surface finish; (5) prevent glazing or loading of chips with fine metallic particles removed while the work is being processed, and (6) soften hard water.

Wet-grinding and deburring compounds are now made in 14 different types and still more are being developed. Each is dentified by a separate number. For example, No. 10, a mildly alkaline, abrasive material, is intended for general application on unhardened metal parts which require a fine matte surface or where deburring is incidental to surface blending or production of a uniformly dull finish. It is also suitable for use with bright-honing chips to polish work prior to bright-honing. However, it is not recommended for application on parts that are finely threaded, have tapped or blind holes, or have deeply recessed slots, in which the compound (or its abrasive) becomes lodged and from which it is exceedingly difficult to remove without special flushing facilities.

No. 11 is a dry, non-abrasive, alkaline compound used with grinding chips for producing a semi-bright finish on both hardened and unhardened ferrous parts in a grinding operation for deburring, removing metal,

Loading a machine

or producing a radius on protruding edges. In addition, it may be employed with bright-honing chips in a polishing operation prior to bright-honing. It is completely water-soluble and free-rinsing, and designed to protect ferrous parts from rusting and tarnishing in process.

When a dull matte finish is desired for blending purposes on unhardened iron and steel parts, No. 12 compound is recommended. It is similar to No. 10 but contains a coarser, harder abrasive. No. 13, incorporating a larger percentage of the hard, coarse abrasive used in No. 12, proves particularly effective in processing work which requires a small chip or an abrasive particle to pass through and finish small apertures such as slots. The slots in castellated nuts or similar articles must, of course, be of sufficient width to assure free passage of the abrasive particles.

Comparatively dry, mildly alkaline and non-abrasive, No. 100 compound is employed for two purposes: with grinding chips to grind, deburr, or produce radii on brass, copper alloy, or zinc-base die cast parts, and with bright-honing chips to deburr lightly and polish non-ferrous pieces.

No. 101 compound is used in combination with grinding chips to remove burrs and tool or wheel marks resulting from previous machining operations and to develop or maintain a bright, lustrous finish on aluminum parts. It also proves suitable in those instances where some surface improvement of a part (a sand casting, for example) is desired. This non-abrasive compound, which must be completely dispersed in the water of the charge, provides the lubrication required for attaining a smooth, slick finish free from surface impingement so frequently encountered in processing the so-called "softer" metals.

Two new compounds, Nos. 117 and 117A, have been developed for use with grinding chips to descale and derust iron and steel work.

No. 117 is a dry, non-abrasive, inhibited acid composition which, added to water and supplemented by the scouring action of the chips, effectively disintegrates and removes heat-treating, forging, or rolling scales, rust deposits or similar tenaciously adherent accumulations in from 30 minutes to 2 hours, depending upon condition of individual parts. From tests already made, it appears that most effective results are obtained by using this compound with a combination grinding chip mass composed of 60 per cent large chips and 40 per cent small chips.

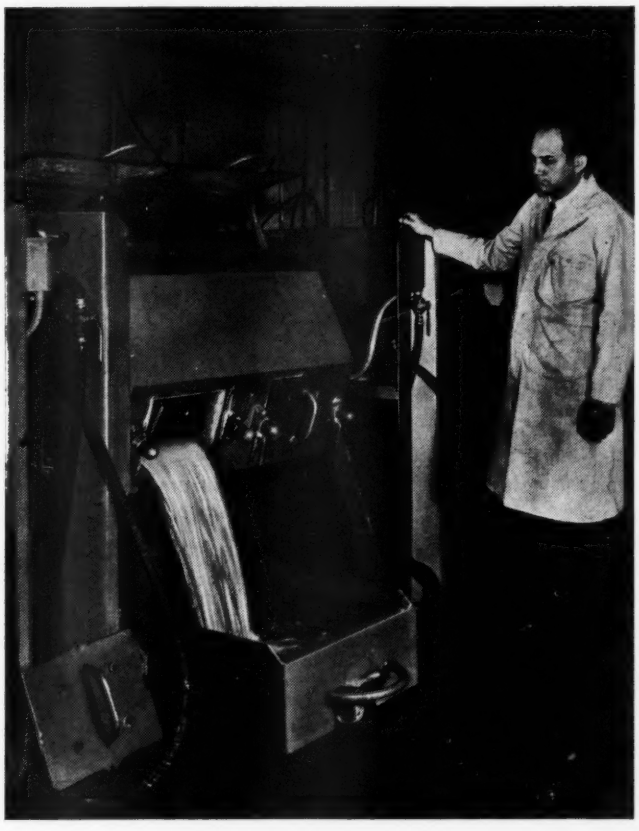
No. 117A, the second new compound, is a dry, non-abrasive blend of alkaline materials designed for neutralizing rust-and-scale-free work; also, it has proved an effective deburring aid when used with grinding chips. One distinguishing feature of this development is that the compound in solution prevents rusting or tarnishing as long as the ferrous work is coated with the solution. Completely water-soluble, it leaves no insoluble residue on parts or chips.

Polishing

Roto-Finish polishing is virtually the same as grinding and deburring with one basic difference: using less abrasive bright-honing chips, it cuts the work more gradually and produces a smoother finish.

Prepared, processed, and screened in much the same manner as the grinding chips, the bright-honing chips are available in the same sizes. From the standpoint of chip depreciation, the rate runs slightly higher for polishing than for grinding.

Unloading a machine



In polishing, as with grinding and deburring, the processing time must be determined in any given instance. In average production practice it has been found to range from 15 minutes to 16 hours, except that when polishing follows a grinding operation, the time is from 4 to 8 hours. The same compounds that are utilized in grinding and deburring are also employed in polishing.

Work-loads generally recommended for wet polishing are given in Table IV.

TABLE IV. APPROXIMATE WORK LOADS PER COMPARTMENT IN WET POLISHING AND BRIGHT-HONING

Machine Model No.	Steel, Brass, Zinc Die Castings		Aluminum Magnesium	
	lb	cu. ft	lb	cu. ft
CW-60-2	100	1	60	0.67
CW-45-2	75	0.75	40	0.40
CW-22-1	75	0.75	40	0.40
AMV-2	3.75	—	2	—

Bright-Honing

Latest developed refinement is bright-honing. Through the use of suitable compounds and less abrasive chips than in deburring, the tumbling yields a fine, semi-lustrous finish on both ferrous and nonferrous small parts. After polished pieces, together with the chips, have been thoroughly rinsed in the compartment, a special honing composition, No. 203, is added to the mass of parts and bright-honing chips. The time for bright-honing ranges from 1 to 3 hours, with most of the brightening taking place within the first hour.

The process proves adaptable to many different types of parts. These include automotive parts; building and plumbing goods and general hardware, fishing tackle and sporting goods, household appliance parts, tools, and business machines parts prior to electroplating, anodizing, or painting.

Parts can be bright-honed directly following forming or trimming if there are no deeply penetrating die and stretcher marks present. Die castings may also be processed directly when they have been trimmed closely. The general work-load recommendations previously outlined for wet polishing operations (Table IV) also apply to bright-honing.

Coloring

Application of this type of mechanical surface treatment is suggested for parts which have been processed by any of the preceding methods or a combination of them. The mass in this case consists not of chips but of steel balls or other highly polished coloring agents.

The ratio of mass to work-load depends upon the size of the compartment. Size of ball used is governed by the size and hardness of the part to be colored. Two specially designed compounds may be used, depending upon whether the work is ferrous or nonferrous.

Compound No. 300 is a highly alkaline blend of water-soluble materials that helps to produce a high luster on iron, steel, stainless steel, and nickel alloy parts only. This particular composition may also be employed in conjunction with grinding or bright-honing chips to descale heat-treated ferrous parts which are only lightly scaled.

A mildly alkaline blend of chemicals, compound No. 350 is used with steel balls or other highly finished polishing media for coloring copper and its alloys, such as brass and bronze, aluminum, and zinc alloys. In addition, it can be used with grinding chips for bright finishing and normal deburring of parts which cannot be bright-honed or colored economically.

Where development of an exceptionally high luster is desired, parts to be colored must first be suitably freed of all oil, grease and scale and also of burrs or other surface defects. In most cases, it has been found advantageous to bright-hone the parts before coloring them.

Recommended coloring ball mass and work-loads are listed in Table V.

TABLE V. BALL MASS AND APPROXIMATE WORK LOAD PER COMPARTMENT IN COLORING

Machine Model No.	No. of Compartments	Ball Mass lb	Steel Brass lb	Aluminum Magnesium lb
CW-60-2	2	1100	35	22½
CW-45-2	2	800	25	15
CW-22-1	1	800	25	15
AMV-2	2	40	1¼	¾

It should be noted that the various work-load figures cited throughout this discussion for grinding and deburring, polishing, bright-honing, and coloring of different metals in every instance represent the approximate work-load under general processing conditions as established by average shop practice. Quite commonly the work-load determined in production may be larger or smaller than indicated, depending on such obvious operational variables as shape, hardness, results expected, and original surface condition of the parts. Weight of work-load is the primary consideration although work-load volume must also be considered when stampings or castings of thin gage material having a relatively large volume in proportion to the weight of the part are to be processed.

Porosity of Electrodeposited Metals

III. MEASUREMENT OF INTRINSIC POROSITY

*Abstract**

This article concerns the measurement of one particular kind of porosity only which the authors call intrinsic or systematic porosity. This kind of porosity is present in perfect deposits free from the gross pores caused by base metal imperfections, dirt in the plating solution, and the like. It is thought to be the fine voids which exist between the crystals of the deposit.

Chemical tests are unsatisfactory, if for no other reason than that they can reveal only an unknown fraction of the pores, namely those which exist over points on the base metal surface which are active to the reagent. Only a portion of the base metal surface is active even if it has been chemically etched.

The new test for intrinsic porosity consists in measuring the rate of flow, at extremely low pressure and under a very low overpressure, of a non-corrosive gas through a plated coating which has been freed from the base metal either by peeling it off a passive base metal surface such as stainless steel or by dissolving the base metal with a reagent that does not attack the coating. After eliminating the results with foils containing gross pores, the authors obtained clear-cut evidence of the existence of intrinsic porosity and a measure of its magnitude.

Experiments with the new porosity test indicate that the finer the grain structure of the deposit, the less is its intrinsic porosity. They also show, and tests with non-corrosive porosity reagents support this finding, that atmospheric corrosion, for example in the laboratory air, rapidly increases the intrinsic porosity of thin metal foils. However, it is believed that gross porosity and gradual gross corrosion of the deposit largely determine its service life.

Critical analysis of the available literature on the subject of porosity of electrodeposited metals[1] has left no doubt about the precarious nature of the evidence on which is based the assumption of the porous structure of electrodeposits. The detection of pores by means of chemical reagents was found open to objections on two counts. In the first place, the indispensable proof that the reagent used is actually harmless to the electrodeposited metal and only detects pores originally present, without causing new perforations in the course of its application, was rarely forthcoming and in no case strictly convincing; a test in which the reagent is shown by gross analytical or visual means not to attack the metal on a massive scale does not necessarily exclude limited mild attack at privileged points, resulting in rapid appearance of tiniest perforations (pores) without appreciable

*By the Editor.

[1] N. Thon and K. T. Addison, Jr., "Porosity of Electrodeposited Metals", Monthly Rev. Am. Electroplaters' Soc. 34, 445–453, 568–576, 722–730, 831–842 (1947); A. E. S. Research Report Serial No. 5.

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loss of mass. In the second place, there was no proof, not even an indication, that any of the chemical reagents will reveal all or even a major—or known—fraction of the existing pores.

This latter point is best illustrated by tests on the same deposit with reagents of different compositions—all of them safe from the point of view of absence of detectable attack on the deposited metal: on a given nickel deposit on iron ferroxyl reagents containing 50 g/l potassium ferricyanide and amounts of sodium chloride ranging from 0 to, say, 0.2 g/l gave entirely different spot counts, the higher the greater the amount of sodium chloride. Evidently, since all these reagents were found to be non-corrosive to nickel, this can only mean that reagents richer in sodium chloride reveal a greater fraction of the existing pores. That this can only be a minor fraction follows from tests with the same reagents on a bare iron surface: on polished iron, pure ferricyanide solution has practically no action; with increasing sodium chloride content, blue spots are formed in increasing number but only at discrete points, forming strings, streaks or networks of blue precipitate; obviously, only a minor fraction of the base metal—only particularly active points on its surface—respond to the reagent at all. The response is considerably greater on an etched surface, but even there it remains definitely discrete and does not in any case come anywhere near being general or continuous. Consequently, the chemical reagent will only detect a pore if that pore happens to be located at a point where the base metal is active towards the reagent.

It is obvious that such a coincidence will be, on the whole, an exceptional rather than a regular occurrence. It can be argued that, in general, a point which is passive towards a chemical reagent will also be inactive towards electrodeposition and preferentially likely to become the site of a pore, unless it be activated by contact with the electrodeposited metal; direct tests showed that no such activation towards high-ferricyanide, low-sodium chloride reagents will take place by contact between iron and nickel. If so, the great majority of pores will simply go undetected by chemical reagents.

On thin deposits, of the order of a micron (40 billionth of an inch), the pore spots revealed by chemical reagents appear scattered and far between when viewed under a microscope. Their number decreases and the average distance between spots increases rapidly with increasing thickness; deposits of the order of ten microns show only relatively few spots, separated by absolutely spotless areas easily extending over a few square centimeters. Particularly with nickel deposits formed on a deeply etched iron surface, total absence of a chemically detectable "porosity" was observed systematically with thicknesses as low as 2 to 3 microns over areas of several tens of square centimeters. On substantially thicker nickel deposits produced under the same conditions, no reliably safe ferroxyl reagent would reveal any pores. Thus, chemical spot reagents fail to demonstrate anything like a systematic porosity of electrodeposits. The conventional spot patterns are far too scattered to be looked upon as a demonstration of a general, intrinsic porosity. Rather, they reveal localized *gross defects* due to accidents of the surface of the base metal or to accidental local contaminations at the surface of the growing electrodeposit. Such gross defects may be statistically unavoidable over extended areas, in much the same way as the incidence of a disease is unavoidable and statistically relatively constant over a large segment of a population; still, the gross defects revealed by chemical tests are accidental and abnormal and in no way intrinsically inherent in the very structure of an electrodeposit, in much the same way as a disease is biologically abnormal and in no way intrinsically inherent in the very nature of a living organism.

This point of view is further corroborated by an observation made on nickel deposits. While a freshly produced deposit appeared practically pore free with a ferroxyl reagent, visible porosity set in after a few days storage of the sample. That this "aging" effect is nothing but beginning corrosion of the deposit is readily demonstrated by the facts that it does not take place if the sample is kept in a desiccator and that it is markedly accelerated if the sample is either heated to about 150° C or exposed in the open. Evidently, beginning, even though yet unnoticed corrosion of the deposit produces localized gross defects which then respond to the chemical "porosity" test.

Against the background of that experience, the whole problem of the existence of a porous structure in electrodeposited metals, and certainly that of its quantitative determination, was thrown wide open. Considerations of the mechanism of growth of electrolytically deposited crystalline metals do, of necessity, lead to the conclusion that intrinsic porosity of such deposits exists. But it was abundantly clear that the haphazard gross defects, or the corrosion damage, which are revealed by chemical test reagents corresponded to no systematic or intrinsic structural phenomenon. One thus was led to search for new methods of detection and of determination of the true systematic porosity of electrodeposits.

Principles of the Method

A suitable method is the determination of the rate at which a non-corrosive gas, driven by a unilateral overpressure, will permeate an electrodeposited foil. Higher porosity will correspond to faster equalization of pressures on both sides of the foil, and vice versa. Any magnitude related to that velocity can serve as a quantitative measure of the porosity of the examined sample.

The method is thus applicable only to electrodeposits separated from their base. This separation can be effected in two ways. The deposit can be produced under conditions of poor adhesion and simply lifted from its base; in this way, tin foils of nickel or of copper are easily prepared by deposition on stainless steel. Or else the base can be dissolved in a reagent which is reasonably harmless to the deposited metal; in this way, silver foils were produced by deposition on iron which was then dissolved in hydrochloric acid, leaving the silver apparently intact.

To avoid mechanical damage to the thin foils, it is necessary to apply very low overpressures, the lower the thinner the foil. Overpressures of the order of a tenth (0.002 psi) or a few tenths of a millimeter of mercury were found safe. Work with overpressures of that order makes it necessary to start with a very low pressure on both sides of the foil, in other words to operate in a high vacuum; an initial vacuum of the order of a thousandth of a millimeter (0.00002 psi) was found convenient.

The measurement consists in reading the change of the pressure difference Δp between the two McLeod gauges as a function of time. In correct operation when leaks are absent, the decrease of overpressure on one side of the foil balances the increase of pressure on the other side.

Description of the Apparatus

Fig. 1 shows the foil holder made of brass or iron. The round sample F of ⅝-inch diameter, punched out of the

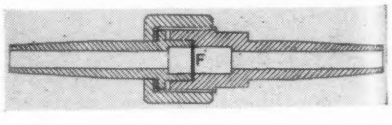

Fig. 1. Cross section of foil holder with Foil F in position. One-third natural size

electrodeposit foil, is held tightly between the two halves of the holder, which are screwed together by means of an external nut. The foil is thus pressed between the two pieces along an outer rim ⅛ inch wide, which ensures satisfactory tightness both with regard to communication between the two halves and to communication with the outer atmos-

phere. Any leak between the two halves of the apparatus, other than through the pores of the open surface of the foil, would be noticeable by a leak across the outer nut to the surrounding atmosphere. Graphitized steel rings under the nut prevent any twisting of the foil in the process of tightening.

The assembled apparatus is shown in Figs. 2-3. The foil holder H is connected with the all-glass apparatus through the metal-glass ground joints G, made tight with the aid of vacuum grease. The double glass-tube loops ensure sufficient springiness to permit pulling the ground joints G apart for removal and reinsertion of the holder H; in these operations, the glass tubes carrying the ground joints are held in a horizontal position by the guides g. VR are two vacuum reservoirs of about 1 liter capacity each. With the two stopcocks S open, high vacuum is produced on both sides of the foil through the three-way stopcock T, by means of a mercury vapor diffusion pump HV, the pressure on each side is measured by the McLeod gauges ML. After evacuation to a low pressure, equal on both sides, one of the two stopcocks S is kept closed and T is turned so as to admit a slight known overpressure of air, Δp_o, from FA (free atmosphere or forepump) through the open stockcock S to one half of the apparatus (on one side of the foil). This overpressure Δp_o is read on the corresponding McLeod gauge. The gauges are manipulated by switching their three-way stopcocks either to the free atmosphere (capillary tips) or a pump P.

Evaluation of the Measurements

The measurements are conveniently plotted in the form log $(\Delta p_o/\Delta p)$ against the time t in minutes, Δp_o being the overpressure initially applied and Δp the overpressure remaining at the given moment. Since $-d\Delta p/dt$ is, at any time, proportional to Δp, the relationship between log $\Delta p_o/\Delta p$ and t is linear. A typical experimental plot is given in Fig. 4.

By the slope of the experimental line, one can determine graphically the time in minutes necessary for the pressure difference to drop to half its initial value, i. e., the time necessary to attain $\Delta p = \frac{1}{2}\Delta p_o$. This magnitude in minutes, to be termed the half-time $t_{0.5}$ characterizes the porosity of the specimen; a longer $t_{0.5}$ means, of course, lower porosity, and vice versa.

Results

Vacuum tightness of the whole apparatus was tested with an empty holder. Tightness of the two halves against each other, across the rim of the holder, was tested by inserting a wrought nickel foil and ascertaining that the overpressure remained unchanged over a prolonged period.

With electrodeposited foils, repeated determinations on the same specimen were reproducible within the limits of the accuracy of the readings of pressure and time. Different samples punched out of different parts of the same electrodeposit foil showed on the whole a remarkable degree of reproducibility, on the average within 10 to 30 per cent, provided utmost care was exercised to avoid distinctly defective areas. Whenever close microscopic examination of a sample revealed the presence of a visible perforation, the $t_{0.5}$ of that sample invariably was found abnormally below that of other sound samples of the same foil. Conversely, an abnormally low $t_{0.5}$ of a sample is a sure indication that it is grossly defective and warrants its rejection. This, again, draws a sharp dividing line between the random gross defects as revealed either visually on isolated foils or by chemical means against the base metal, and the systematic porosity evidenced by the gas permeation method.

If, as we feel justified in doing, samples with abnormally low $t_{0.5}$ are eliminated, then the variation of the intrinsi- porosity with the thickness of the foc becomes quite regular. This regularitil and reproducibility clearly demonstratey that *an intrinsic structural porosity acs tually exists in electrodeposited metals* and is a regular function of their thickness.

The absolute values of the half-times measured in our setup depend, of course, on its particular dimensions, i. e., on the surface area of the foil and the volumes on both sides. The exposed area of the sample in our holder is about 0.7 cm². In order to gain a suitable conventional expression for the porosity of a foil, we define a "standard half-time" $T_{0.5}$ in minutes x cm²/liter, as the reciprocal rate constant k of the decrease of the pressure difference at standard area and volumes. Between two equal volumes V (in liters) separated by a porous membrane of surface area F (in cm²), the rate of decrease of the pressure difference at a given moment is

$$-\frac{d\Delta p}{dt} = \frac{F}{V/2} k \times \Delta p$$

On integration

$$\frac{1}{k} = \frac{2F}{2.303\,V} \times \frac{t}{\log(\Delta p_o/\Delta p)} = T_{0.5}$$

or, since at $t = t_{0.5}$, $\Delta p_o/\Delta p = 2$, and log $(\Delta p_o/\Delta p) = 0.3010$, the "standard half-time"

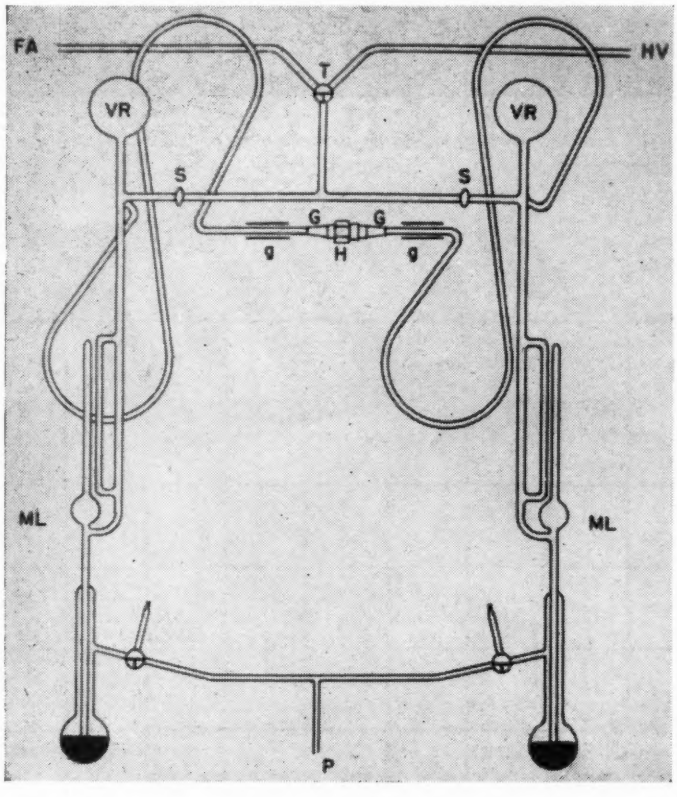

Fig. 2. Diagram of low-pressure gas-permeation apparatus. (H) foil holder, (G) metal-glass ground joints, (g) guides, (S) stopcocks, (T) three-way stopcock, (FA) to free atmosphere, (HV) to high-vacuum pump, (VR) vacuum reservoir, (ML) McLeod gauges, (P) pump

$$T_{0.5} = \frac{2\,F}{2.303\,V \times 0.3010} \times t_{0.5}$$

In the case of our apparatus, this gives

$$T_{0.5} = 2.1\,t_{0.5}$$

a. e. s. research

in other words, to convert the experimental half-times $t_{0.5}$ to the "standard" $T_{0.5}$, one has to multiply by 2.1. Plots of $T_{0.5}$ against the thickness in microns for foils of nickel, copper, and silver are shown in Fig 5.

The similarity of the shapes of the curves for the three different metals is striking. They all show a relatively slow decrease of the porosity with increasing thickness in thin deposits, and a nearly vertical fall of the porosity beginning at a certain thickness. On the other hand, absolute values are widely different for different deposits. In particular, nickel deposits (produced in a low-*p*H warm sulfate-chloride bath) of a given thickness are considerably denser than silver of the same thickness (produced in a cyanide bath without brightener); this is in keeping with the much finer structure of the nickel as contrasted with the visibly coarse structure of the silver. The intermediate position of copper (produced in a cyanide bath) is also in accord with the appearance of the grain of the deposit.

It should be pointed out, parenthetically, that silver may well be attacked to some extent in the process of dissolution of the iron base; to obtain a regular curve it is necessary to carry out this operation under strictly controlled conditions.

The method obviously provides a means of *relative* evaluations of the porosity of thin metal foils.

Detection of Beginning Corrosion

The conventional evaluation of corrosion in terms of loss of weight, of perforations, etc., or in terms of arbitrary visual scales, is admittedly unsatisfactory. Furthermore, ratings based on such observations or estimations are only applicable when corrosion has progressed relatively far; there is no way of detecting corrosion at its very earliest stages when there is no visible damage and the loss of mass is still insignificant. The low-pressure gas permeation methods provide a convenient tool for the detection of such early and, practically, imponderable corrosive effects, and permits their quantitative expression on the half-time scale.

A few observations made in that direction showed quite surprising results. Thus, a 5-micron nickel foil which had been kept for a number of weeks in a drawer instead of a desiccator had a $t_{0.5}$

(*Concluded on page 967*)

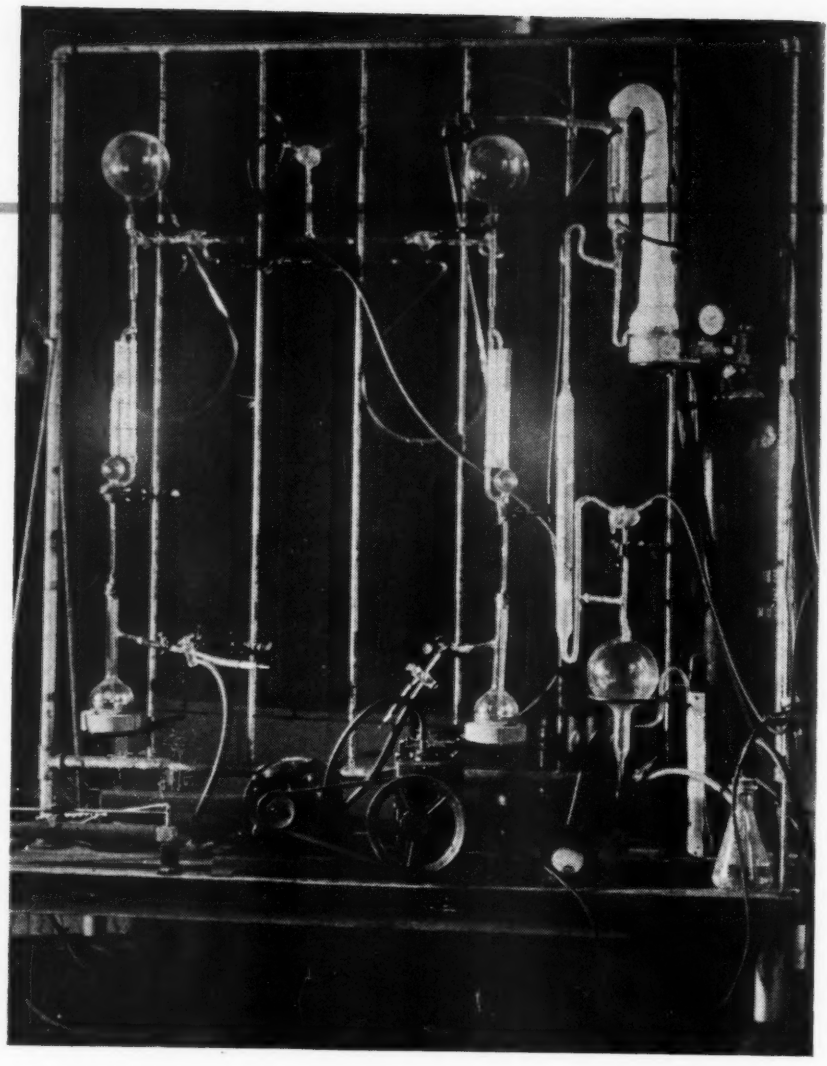

Fig. 3. Front view of assembled gas-permeation apparatus. Mercury vapor pump at right

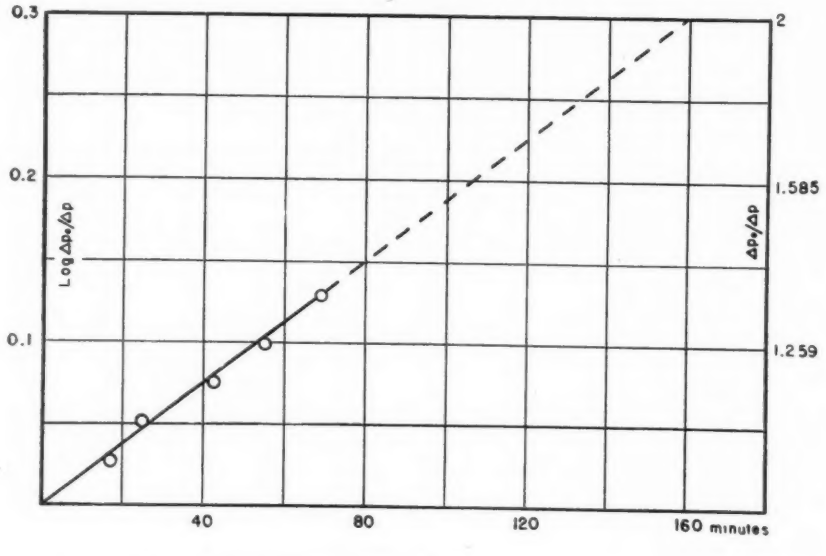

Fig. 4. Plot of experimental observations for one run. The line has been extrapolated to log $\Delta p_0/\Delta p = 0.301$ to find the half time $T_{0.5} = 160$ minutes of this foil

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Methods for Testing Thickness of Electrodeposits

I. EFFECT OF INTERNAL STRESS ON THICKNESS DETERMINATIONS BY THE JET METHOD

*Abstract**

This report shows experimentally that internal stress in an ordinary gray nickel deposit reduces its apparent thickness as determined by the jet test method proposed by Clarke and widely used in England. Restressing after stress relieving has the same general effect. High temperature annealing, which is accompanied by grain growth, raises the apparent thickness much more than stress relieving at lower temperature, and restressing after high temperature annealing only partially restores the nickel to normal reactivity.

The significance of these findings is that a chemical rate-of-reaction thickness test like the jet test must be viewed with much suspicion and used only, if at all, after it has been calibrated for the particular deposit at hand. Not only internal stress but also other physical conditions are likely to throw off the results; since these conditions are usually unknown to a purchaser of plated coatings or ware, he should employ such tests for purpose of acceptance or rejection only after he has assured himself that these physical conditions are absent or have no effect.

Introduction

The literature contains numerous papers describing methods for determining the thickness of electrodeposits which depend upon the rate of a chemical reaction, e. g., the jet and dropping methods. Many of these require very little in the way of equipment, and the execution of a determination is simple and rapid for an apparent or reported accuracy of about 10 per cent. It would appear, therefore, that their use should be widespread. The fact remains, however, that at least in this country, no extensive use is made of these methods for routine control or inspection, except of zinc and cadmium coatings. Various reasons have been given, and among these lack of reliability is outstanding, particularly in the case of the jet test for nickel.

It appears desirable to examine the situation and see why it is that an ostensibly satisfactory method has failed for general use. One avenue of approach is to assume that small changes in technique may greatly affect the results. In this respect the work of Ballay and Ginguene[1] is of great interest. These authors investigated rather extensively the effect of mechanical variables within the test itself on a typical chemical reaction rate method, namely, the dropping test for zinc coatings. The experiments demonstrated that reasonable variations in technique did not markedly affect the results. This work and scattered reports by other authors make it appear that as far as the actual execution of the test is concerned, no trouble should be encoun

*By the Editor.

tered in using it in the plant as well as in the research laboratory.

There remains the possibility that variables within the deposit may be the source of trouble. There is ample indication of this in a paper by Clarke[2] where it is reported that the factor used in calculating thickness of nickel from the results of the jet test depends upon the bath from which the nickel was plated. The question arises at once as to why this should be. In what way does the nickel from a bath of one type differ from the nickel from another? Is it a matter of chemical composition, e. g., the presence of impurities, or are there physical factors involved as well?

The recent interest in the measurement of stress in electrodeposits and the demonstration of the rather large magnitude of the internal stress in many cases leads to speculation as to the effect of stress on chemical rate methods of determining thickness. Here is a case where a physical condition of the deposit may affect the results since it is well known that the presence of stress in a metallic body often increases the rate of corrosion of the body in ordinary corrosive environments[3]. In all cases, however, the tests referred to have been carried out under conditions where the rate of chemical reaction was very slow compared to that used in a jet or dropping test. It might well be that effects which were noted at slow rates of reaction would not be apparent at high rates. To test this idea a series of experiments has been carried out in which the thickness of nickel plated specimens was determined as plated, after low temperature stress relief treatment, and after annealing at somewhat above the recrystallization temperature to ensure complete stress relief. The specimens so treated were then restressed mechanically and retested to see if effects other than stress relief were introduced during the heat treatments.

Experimental

The specimens were prepared in a rectangular "Lucite" tank of the Haring Cell type[4]. It was established in other experiments that a specimen could be prepared in which there was no detectable difference in thickness from place to place on the specimen over the area taken for tests, at least within the accuracy of the microscopic method which was used for the purpose. The tank was mounted in a water thermostat, and the plating solution temperature was controlled to within ± 1° F.

The basis metal was cold rolled steel with a No. 3 finish which was not polished or buffed. After degreasing with xylene, the steel was scrubbed in a hot alkaline cleaner, rinsed, dipped in 10 per cent sulfuric acid, rinsed, and plated.

All deposits were made directly on the steel from a bath of the following composition:

Nickel Sulfate	225 g/l
Nickel Chloride	50 g/l
Boric Acid	50 g/l
*p*H (electrometric)	5.0
Temperature	140° F

The solution was purified by adding nickel carbonate in slight excess, treating with hydrogen peroxide, and holding at elevated temperature in contact with activated carbon. The volume of solution prepared was several times that necessary to fill the tank for a run, and the entire solution was filtered frequently. Hydrogen peroxide was added in amounts sufficient to control pitting.

During the plating operation the solution was agitated every five minutes by gentle stirring with a glass rod.

The time of electrolysis at the various current densities at which specimens were prepared was regulated to give a calculated thickness of 0.001 inch.

The jet test apparatus and procedure was that recommended by Clarke[2] and need not be described here. It may be of value to mention that it was found desirable to store the jet in a test tube filled with the test solution between periods of use, a procedure which helps in preventing a change in rate of flow from one test period to the next. After a preliminary run on each specimen had established the approximate time for penetration, at least six tests could be made on the available area with a reproducibility of 5 per cent or better in the time measurement. Ample time was always allowed for the specimens and solution to come to room temperature, and precautions were taken to avoid mechanical disturbance of the apparatus during a test.

The microscopic thickness determination was used as a control method. All specimens were prepared in the same way by one individual, and the results were reproducible. Duplicate test pieces were sawed from the samples by means of a band-saw equipped with a fine-toothed blade, and were mounted in steel clamps between soft brass pads. After about one-sixteenth of an inch of metal had been removed by means of a shaper to avoid material which might have been distorted during the sawing operation, the specimens were polished in the usual way through 000 emery paper and finished on a silk wheel with 15-minute levigated alumina. Good interface contrast was obtained by etching the basis metal with 2 per cent nital (2 ml of nitric acid in 98 ml of 95 per cent ethyl alcohol) and the brass separating strips with an etchant consisting of 5 parts (by volume) ammonium hydroxide, 5 parts water, and 3 parts 3 per cent hydrogen peroxide. At least five measurements were made on each test piece.

The internal stress in each of the plated specimens actually used in the investigation was not measured because of the fact that it was necessary to plate the nickel on a basis metal which was too thick to allow of the use of the methods of stress determination recently described[5,6]. Preliminary experiments had shown that the heat treatments and restressing operations were not practical on the thin basis metal stock which is necessary for stress determination by the flexure methods. It was clear from available data[5,6] that the solution described above when used under the stated conditions would give an internal stress of about 25,000 psi. This was confirmed for the solution actually used by test runs in which shim stock was used as the basis metal. While it would have been desirable to have measured the internal stress in each specimen, it is felt that there is sufficient evidence available to justify the assumption that the "as-plated" specimens were stressed to the extent of approximately 25,000 psi. Furthermore, the object of these experiments was simply to determine whether internal stress affected the chemical rate method and not necessarily to relate internal stress to rate of reaction in a quantitative way.

The jig which was used to restress the deposit on stress-relieved or annealed specimens is illustrated in Fig. 1. The diameter of the rod shown beneath the middle of the specimen determined the amount of stress introduced into the specimen, and was so chosen in this work as to give a stress in the deposit of about 25,000 psi.

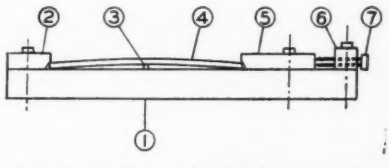

Fig. 1. Jig for mechanically restressing stress-relieved or annealed specimens (1) Base, (2) stationary end block, (3) 2-inch long, 1/16 inch dia. rod, (4) 3½ inch long specimen, (5) sliding end block, (6) bolt support, (7) adjusting bolt

The results summarized in this paper were obtained from nine plated sheets of which three were plated at each of three current densities, namely, 2, 4, and 6 amp/dm² (18.5, 37.1, and 55.6 asf). Each sheet was cut into three equal sections, designated A, B, and C, which were treated as follows:

Section A.—Thickness determined by jet and microscopic methods in the as-plated condition.

Section B.—Annealed 2 hours at 650° F for stress relief[7], and thickness determined by the jet method. The specimens were then restressed to about 25,000 psi, and

the thickness redetermined by the jet method.

Section C.—Annealed in a hydrogen atmosphere at 1697° F (sections placed in a cold furnace, raised to the desired temperature in about five hours, maintained at this temperature for two hours, and then allowed to cool with the furnace) and thickness determined by both the jet and microscopic methods. The specimens were then restressed to about 25,000 psi, and the thickness redetermined by the jet method.

Discussion of Results

The results of the thickness determinations on the various specimens are shown in Figs. 2 and 3. The factor used in calculating the thickness from the time taken for penetration in the jet test was obtained from a curve in Clarke's paper[2] where the dependence of the factor on temperature for the test solution used in this investigation is indicated. Since the plating time was the same for each of the sheets plated at a given current density, the thickness determinations of nickel on specimens plated at the same current density and subjected to the same heat or mechanical treatment should be in agreement and capable of being averaged. Such was, indeed, the case, and each point on Figs. 2 and 3 represents the average of values obtained from three different specimens, which values were in turn the means of six or more individual determinations.

In Fig. 2 the average values for thickness have been plotted against current density. The vertical lines at or connected with each of the plotted values indicates the standard deviation[8] of that value. It is obvious that significant differences in the results of the jet test have been caused by physically changing the character of the deposit by means of heat or mechanical treatments. The magnitude of the standard deviation for each of the plotted values precludes experimental error as a source of the differences. The actual thickness of the coatings was not altered as a result of the heat treatments since microscopic measurements before and after heat treatment agreed within the limits of experimental error.

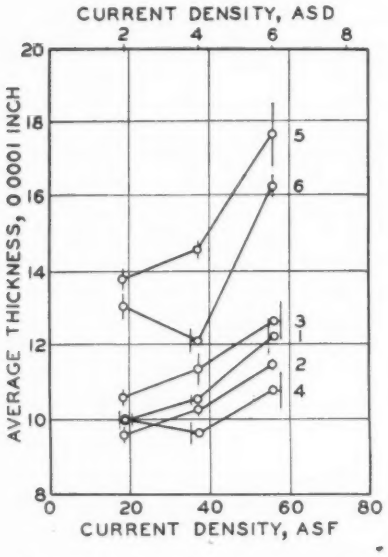

Fig. 2. Graphical summary of results of thickness determinations of nickel deposits on steel by jet test and microscopic methods. Vertical lines represent the magnitude of the standard deviation for each plotted average value. (1) Microscopic measurements, (2) jet test measurements of "as-plated" coatings, (3) jet test measurements after stress relief at 650° F, (4) jet test measurements after stress relief and restressing, (5) jet test measurements after anneal in hydrogen at 1697° F, (6) jet test measurements after anneal at 1697° F and restressing

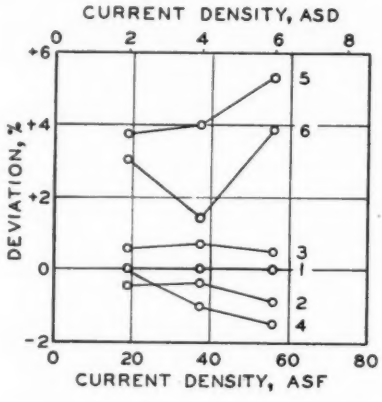

Fig. 3. Deviation of jet test measurements in Fig. 3 from microscopic measurements

In order to eliminate the rather confusing factor of the variation of thickness in the as-plated condition with current density, Fig. 3 was prepared. It has been assumed here that the microscopic measurements are correct, and the deviations of the values obtained by the jet test from those obtained by microscopic measurements have been plotted against current density. For the sake of clarity, the vertical lines representing standard deviations have been omitted from this figure.

In Fig. 3 it will be noted that the microscopic and jet test curves for the as-plated specimens are quite close together. When one considers the jet test results on as-plated specimens compared to those which have been stress-relieved at 650° F, it is seen that the latter gave results which are about 10 per cent higher. This means that the rate of chemical reaction has been reduced, which, of course, agrees with the results of corrosion studies to which previous reference has been made[2]. After having been restressed to about 25,000 psi the deposit became more reactive again although, as shown by the curve in Fig. 3, the jet test results were now more variable with respect to current density.

The upper two curves in Fig. 3 illustrate the effect of complete annealing of the deposit and of annealing followed by restressing to about 25,000 psi. It is evident at once that the rate of reaction of the nickel with the test solution is greatly affected by the annealing operation and that something other than stress is involved since simple stressing to an extent which was on the average more than ample to restore reactivity in the stress-relieved specimens was not enough to restore the annealed specimens to their original reactivity. It will be observed, also, that variations with respect to the current density at which the specimens were plated are of considerable magnitude. The marked decrease in chemical reactivity as a result of annealing may be due to the grain growth which would be expected as a result of the heat treatment. This, however, is sheer speculation since the effect of grain size on chemical reactivity is not well understood[3].

No explanation is offered to account even qualitatively for the variations of chemical reactivity (as denoted by variations in the jet test results) connected with changes in the current density at which the nickel deposit was prepared. Since it is known, however, that the fineness of structure of a deposit may vary with the current density during deposition, the results are not surprising even if they are inexplicable. It should be mentioned, incidentally, that Phillips and Clifton[6] have shown that the internal stress of nickel deposited under the conditions used in these experiments does not vary to any great extent with current density, at least within the range of interest here. This is additional evidence that physical, mechanical or structural properties other than stress may have an untoward effect on methods of thickness determination which depend on the rate of a chemical reaction.

It may be suggested that the apparent slowness of reaction of the heat treated specimens was due to surface conditions which delayed the start of attack and hence gave a false time interval. There are several reasons for believing that this is not a valid objection. All specimens, whether in the as-plated condition or heat treated, were rubbed with magnesium oxide prior to testing as recommended by Clarke[2], and visual observation indicated that after this treatment all of the specimens reacted at once with the test solution. If surface conditions were delaying the start of the attack, it would be expected that the reproduci-

(Concluded on page 936)

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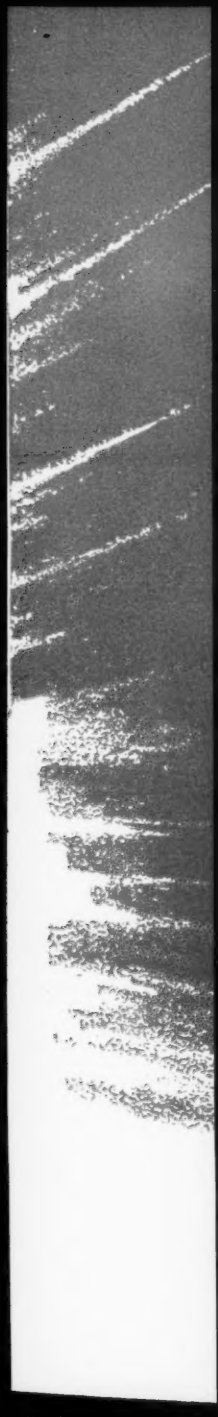

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A. E. S. Manual for Electroplaters' Science Course

By WILLIAM BLUM, *Chairman*

FRANK L. CLIFTON AND ALBERT HIRSCH

Special Committee on Education of A. E. S. Research Committee

Introductory Remarks

The following manual for use by teachers of classes for electroplaters was prepared at the request last year of the then First Vice-President of the American Electroplaters' Society, S. S. Johnston, now the Society's President. The Research Committee, in undertaking this responsibility, in effect served as an advisory committee to the Society on educational matters.

Preparatory to the writing of the manual, a request was sent to all A. E. S. Branch secretaries for information regarding classes held in recent years. The replies thus far received from 16 Branches indicate that classes are now being held in at least nine localities. The fact that eight of these classes are being given by educational institutions is especially gratifying because it demonstrates an increased interest in the education of electroplaters and that the teaching experience and facilities of these institutions have been made available to these worthwhile projects.

The outlines of courses given in different classes show a wide diversity of details, with, in general, considerable emphasis on fundamental principles of physics and chemistry. Because the subjects presented may wisely be varied in different locations according to the types of plating there practiced, the education of the students, the experience of the teacher, and the available teaching facilities, it is not practicable to prescribe the details of a "standard" course. Instead, an effort has been made in the manual to suggest the most important topics and a convenient order of presentation. It is hoped that this manual will be helpful as a guide to teachers of such classes.

The rapid scientific and technical advances in electroplating during the past decade can be fully and promptly utilized only by those platers who understand the basic principles of chemistry and physics upon which electroplating rests. The committee feels strongly that every Branch should sponsor or support appropriate classes, given at least once in five years or oftener. If teachers of such classes make use of this manual, modify it when expedient, and inform the A. E. S. of their experience and suggestions, it may be possible within a few years to prepare a more comprehensive manual for such classes. To insure continuity, this information should be sent to the Chairman of the Research Committee.

THE MANUAL

I. Purpose and Scope of the Classes

Many thousand persons now engaged in electroplating are not sufficiently familiar with the basic science in this field to understand the reasons for the various operations they perform. Lack of such a foundation stunts their efficiency, their opportunity to advance, and their ability to plan, direct, and supervise plating operations. The proposed course is planned to meet this need and especially to assist competent persons to become foremen of plating plants.

In an increasing number, especially in large plants, chemists and engineers are now employed to design and control plating processes and equipment. It might appear that in such plants there would be less need for technical knowledge on the part of the operating staff. Actually it is very essential that persons who conduct the plating operations should be able to understand the laboratory reports in order to apply them to the processes used.

In general, professional chemists and engineers will have graduated from courses that include the important relevant branches of science but usually little direct instruction in electrochemistry, much less in electrodeposition. It is doubtful whether undergraduate college courses designed to educate personnel specifically for the plating industry are warranted, and no effort is made in this manual to cover such courses.

Similarly, persons engaged in researches on electrodeposition may undertake post-graduate studies to fit them for advanced work in various phases of this field. Again, no specific course for them is suggested in this manual.

There are two important groups who may desire a course in electroplating. The first group comprises those persons who are working in plating plants and who must secure their education in the evenings. The other group consists of young persons, at present especially G. I.'s, who wish to learn how to do plating and hope to secure school instruction that will fit them for positions in this field. One difficulty in planning courses for the second group is that, to be self-contained, they should include instruction in various plating and finishing operations for which very few vocational schools have the equipment and experienced teaching personnel. If such a full-time vocational course is given, it should include instruction in science at least equivalent to that outlined in this manual.

The course here outlined is intended of assist instructors to meet the needs to those persons engaged in plating who have had no more than a grade school or possibly a high school education. No reference is made to the teaching of the manufacturing operations, which can best be learned in the plant. This course is designed for at least one three-hour session per week (normally in evenings) for two school years, each about 32 weeks. More time may be devoted if available, but any less time will preclude adequate instruction. More advanced courses may also be given.

The course outlined can be given in the average high school or trade school laboratory, provided some special equipment or supplies are furnished, e. g., by a local A. E. S. Branch or a supply house. It is not necessary that the instructor be experienced in electroplating, but he should visit the local plants to aid him to relate the teaching to plant problems. In addition, a small local committee, of e. g. three plating chemists or platers, might be appointed to advise the instructor.

In general, it will be found desirable to devote about one hour each evening to a lecture or demonstration and two hours to laboratory work. For certain

subjects it may be expedient to devote an entire evening to lectures and demonstrations. Because of the short time available, several laboratory instructors are usually desirable and may be drawn from the local plating chemist. It is not necessary that each student do every experiment. Often it is an advantage for the students to work in pairs in order to complete an experiment in the limited time at their disposal

No attempt is made in this manual to cover the details of each subject. The instructor can get the necessary information from general texts in chemistry and physics and from special texts in electrochemistry and electrodeposition. In addition, the students should make use of some textbook on plating. It is usually desirable that the instructor prepare and distribute mineographed outlines of the lectures and specific directions for each experiment. Simple numerical problems may be included for the students to work out at home.

Since the course may vary according to the available equipment or the specialized needs of the locality, it is doubtful whether preparation of detailed sheets for general use will prove warranted at this time.

II. General Outline of Courses

First Year

	Periods
1. Elementary Chemistry	8
2. Electricity and Electrochemistry	8
3. Analysis of Plating Solutions	8
4. Testing of Deposits	8

Second Year

5. Principles of Electrodeposition	8
6. Plating Processes	24

It might appear preferable to postpone the analysis and testing until more knowledge of principles has been gained. Practically, however, the plater is likely to make direct use of the analysis and testing, knowledge of which will then stimulate him to further study.

In the following outline, subjects for each three-hour period are suggested. It is recognized that circumstances and experience may justify more or less time for any topic.

III. Rough Outlines of Courses

First Year

1. Elementary Chemistry
   - (a) Elements, compounds, mixtures. Atoms, molecules, ions, electrons, etc.
   - (b) Physical changes: melting, boiling, etc.
     Physical properties
     Chemical changes: combination, decomposition, double decomposition
     Chemical properties
   - (c) Valence. Chemical equations
   - (d) Oxidation and reduction
   - (e) Electrolytic dissociation
   - (f) Acids, bases and salts. Neutralization
   - (g) Normal solutions. Titrations
   - (h) *p*H system

2. Electricity and Electrochemistry
   - (a) Electrical units and terms
     Direct current
     Alternating current
   - (b) Electrical sources: batteries, generators, rectifiers
   - (c) Distribution of current
     Arrangement of tanks and sources
     Series and parallel connection
   - (d) Faraday's law
     Current efficiency
   - (e) Electrode potentials: single potentials, polarization, overvoltage
   - (f) Resistance of solutions: definitions, measurement, heat produced
   - (g) Corrosion. Protective coatings
   - (h) Special topics

3. Analysis of Plating Baths
   - (1) General
   - (a) Qualitative
     Quantitative
     Gravimetric
     Volumetric
     Acidimetry
     Oxidation and reduction
   - (b) Precipitation
     Cyanometric
     Colorimetric and spectrophotometric
     Spectographic
     Polarographic
   - (2) Analysis of solutions
   - (c) Sampling
     Alkaline cleaning solutions
     Acid pickles and dips
   - (d) Acidity and *p*H
   - (e) Copper
   - (f) Chromium
   - (g) Nickel. Chloride
   - (h) Free cyanide. Silver

4. Testing of Deposits
   - (a) Thickness
     Microscopic methods
     Stripping methods
   - (b) Dropping test
     Jet test
   - (c) Magnetic methods
   - (d) Hardness and wear resistance. Adhesion
   - (e) Structure. Stress
   - (f) Brightness. Porosity
   - (g) Corrosion resistance
     Accelerated tests
   - (h) Special topics

Second Year

5. General Electrodeposition
   - (a) Polarization
   - (b) Overvoltage
   - (c) Current distribution
     Throwing power
   - (d) Addition agents and brighteners
   - (e) Surface tension. Viscosity. Wetting agents
   - (f) Effects of basis metal
   - (g) Types of bath
   - (h) Materials of construction. Insulators. Stop-offs

6. Plating Processes
   - (a) Cleaning
   - (b) Pickling and dipping
   - (c) Electropolishing
   - (d) Anodizing
   - (e) Stripping
   - (f) Plating on various metals and plastics
   - (g) Purification of baths
   - (h) Acid copper
   - (i) Cyanide copper
   - (j) Silver
   - (k) Gold
   - (l) Zinc
   - (m) Cadmium
   - (n) Indium
   - (o) Tin
   - (p) Lead
   - (q, r) Chromium
   - (s) Iron
   - (t, u) Nickel
   - (v) Platinum and rhodium
   - (w) Brass
   - (x) Special topics

For each type of bath, an effort should be made to explain and illustrate the functions of each constituent and the effects of variations in bath composition, temperature and current density on the deposits.

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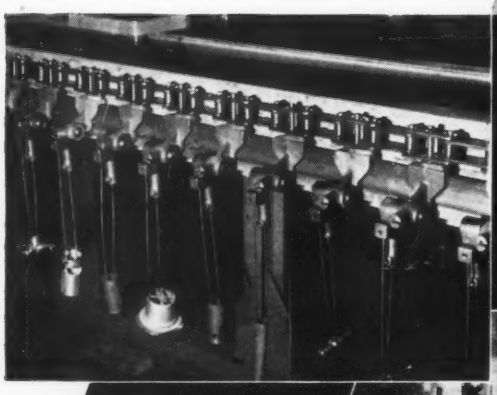
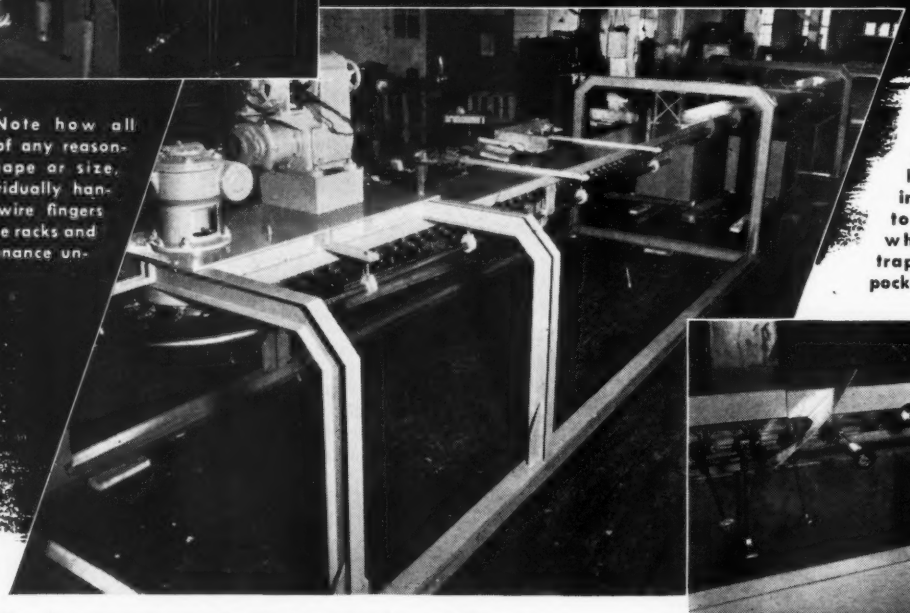


Note how all parts, of any reasonable shape or size, are individually handled on wire fingers which make racks and rack maintenance unnecessary.



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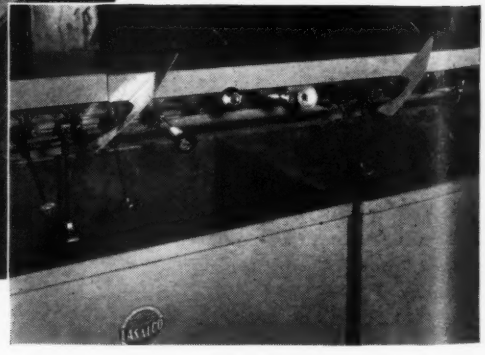

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The Question Box

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Q. 29. What are the best methods for plating block tin, pewter, and other soft metals?

A. An investigation of several years ago of full-automatic bright nickel-chromium plating of hot tinned refrigerator shelves showed that a copper flash in a Rochelle salt bath over the tin was necessary for good adhesion and appearance. Bright nickel directly on the tin would not do, even though mild cleaning solutions were used and strong acid dips avoided. It is likely that the higher temperature, lower *p*H modern nickel baths make plating of tin surfaces more difficult than with the old-fashioned double nickel salt solution.—The following procedure has been used successfully for plating both a pewter containing 90 to 91 per cent tin, 7 to 9 per cent antimony and ½ per cent copper and lead castings containing 13 per cent antimony with and without a small percentage of tin; (1) Low *p*H alkaline soak cleaner of 160 to 180° F for 5 to 10 minutes; (2) rinse; (3) swab or brush with a cotton wick, tampico, or nylon brush dipped in water or, to remove impacted buffing compound, in the cleaner solution; (4) wheel brush with nickel-silver brush or, if scratches are objectionable, with fibre bristle brush; (5) sponge when pumice has been used on wheel brush to produce a soft finish; (6) dip in 3 to 6 oz/gal sodium cyanide solution; (7) rinse; (8) electroclean cathodically in mild alkaline cleaner of 180° F for ½ minute; (9) rinse; (10) nickel strike in cold double nickel salt solution for 2 minutes or until the article is covered (deeply recessed or soldered parts may preferably be given a strike in a Rochelle salt copper bath and, if desired, rinsed thoroughly and given a nickel strike; (11) rinse; (12) cyanide dip; (13) silver strike; (14) silver plate.—Lead plates used on castings are normally handled through a weak alkaline cleaner, rinsed, brushed if necessary, rinsed, given a weak acid dip, rinsed thoroughly, copper plated, oxidized, and sent to dealers who engrave the name perhaps several months later. No difficulty is encountered with plates made of chemical lead or regular lead-antimony alloy, but plates of secondary lead cannot be engraved without lifting of the copper plate. In this case, the usual silver strike followed by rinsing should be used prior to copper plating.—M. B. Diggin.

A. Very often excellent coverage of lead and lead alloys can be had by using a silver strike at about 40 asf. A suitable composition is ⅓ to ½ oz/gal silver cyanide, 6 to 7 oz/gal free sodium cyanide, and 2 to 3 oz/gal sodium carbonate.—R. A. Schaefer.

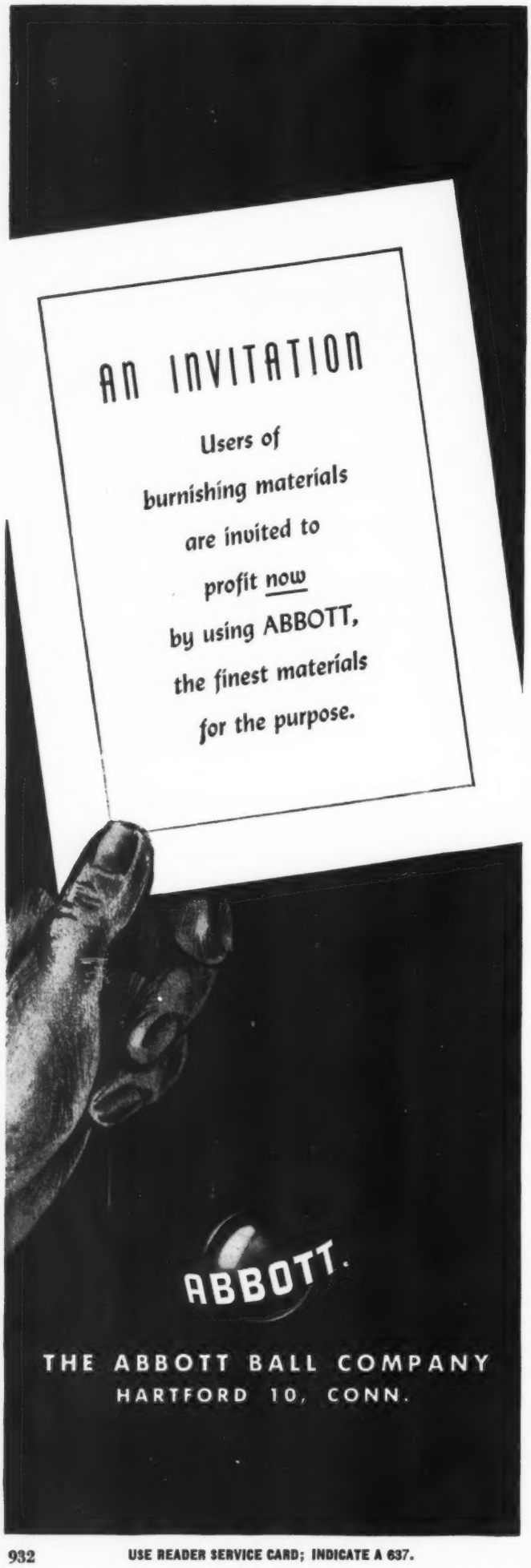
A. See also W. R. Meyer and C. C. Helmle, "Electroplating on Lead-Antimony Alloys". Proc. Am. Electroplaters' Soc. **23,** 129–138 (1935); Mo. Rev. Am. Electroplaters' Soc. **23,** No. 3, 7–23 (1936).—Editor.

Q. 30. We have just begun chromium plating of Diesel liners and use this procedure: (1) Pregrind, (2) hone, (3) electroclean, (4) cold rinse, (5) tampico brush with pumice, (6) rinse, (7) dip in 1:1 muriatic acid, (8) rinse, (9) reverse etch in chromium bath for 1 minute, (10) chromium plate at 2½ to 3 asi, (11) grind the chromium. Please comment in view of the following: After grinding, the plate exhibits spots which look like they had been touched by an arc welding electrode. Very light liners only show checks and cracks which seem to follow the porosity pattern.

A. Your procedure is satisfactory.—If you are looking for a "porous" plate, a crack-type porosity is had with a sulfate ratio of 120 to 125 and a bath temperature of 128 to 130° F and a pit-type porosity at a ratio of 95 to 100 and 118 to 120° F. If you desire a regular hard plate, use a ratio of 95 at a temperature sufficiently high and current density sufficiently low to prevent cracking. Stress relief before grinding helps eliminate the cracks.—The spot effect sounds like either a nodular condition caused by too high an iron and trivalent chromium concentration in the bath or like heat spots caused by poor contacts.—I strongly suggest that a competent chromium plating engineer be asked to study these rather complex problems on the job.—A. W. Logozzo.

Q. 31. How can I separate a copper deposit from a chromium plated mandrel?

A. Separation has been satisfactorily accomplished by using a die with an aperture equivalent in size to the outside dimensions of the mandrel. The die effects separation by a sudden impact, such as would be produced by a mechanism operated by an air cylinder, against the shoulder of the electroformed article. Separation by this method, of course, requires that there be some small dimensional relief in the direction of stripping and also that there be no creepage of the electroform over the edge of the mandrel where separation is to be initiated. A film of graphite applied to the mandrel before electroforming will facilitate separation. Such a film can be applied in the form of a water dispersion of colloidal graphite. Separation will also be facilitated by having the chromed surface as highly polished as possible.—C. L. Faust.



Book Review

by DR. HAROLD J. READ,
Associate Professor of Metallurgy
The Pennsylvania State College

CHEMICAL AND ELECTROPLATED FINISHES by H. Silman, 1948, xiii+414 pages. Chapman and Hall, Ltd, 37 Essex Street, W. C. 2, London, England. Price 30 shillings.

Most of the current British books concerned with electrodeposition tend to make American readers feel that plating practice in England is antiquated with respect to both processes and equipment. The new volume by Mr. Silman will do much to dispel this impression, particularly insofar as the latter item is concerned. Many of the excellent illustrations depict items of equipment such as automatic plating machines, automatic polishing and cleaning units, degreasers, etc., which compare very closely with those presently used in modern American plants. It is not indicated how widespread the use of such machines may be, but they are at least available.

Although the author places prime emphasis on the presentation of practical information, he has also included at appropriate places considerations of the physical and chemical principles involved in many of the processes. In most cases they are too brief to be of interest to the research worker, but the plant operator should find them of value in helping him to understand what he is doing.

The book is very comprehensive in its general scope, but at the same time there is an abundance of detail which is surprising when one considers the fairly modest size of the volume. The author is a skillful writer, and he has in no wise obscured the clarity of his presentation by the inclusion of these manifold minutiae.

While the book is annotated to some extent with references to the journal literature, they are by no means numerous or exhaustive. Since the volume was not intended to be a reference text, this situation is not in itself open to objection, but one wonders if a better selection of references could not have been made in those instances where they are given. In some cases Mr. Silman quotes only rather obscure papers, and fails to refer to the work of outstanding authors who have been closely associated with the development of the process under consideration; e.g., there is no reference to the work of Faust in the section on electropolishing.

The very numerous, informative line drawings and halftones are a great asset to the book, and adequate name and author indexes are included.

Abstracts

For copies of original articles, turn to your Public Library for photostats or addresses of the publications in question

Fluid Mechanics: Forgotten Factor in Electroplating—Part II. Joseph B. Kushner. Metal Finishing 46, 63–67 (January, 1948).
Discusses surface tension; adhesion, cohesion, and wetting; surface tension in metal cleaning; surface tension and dragout; surface tension and pitting and nodules; and surface tension and bright plating.

Health Hazards of Metal Cleaning Compounds. Part II. P. M. Van Arsdell. Organic Finishing 8, 30–33, 36–38, 45 (December, 1947).
A summary of toxic properties of benzene, toluene, xylenes, ethyl benzene, and coal-tar solvents. Tables show the compositions of various proprietary metal cleaners and data on maximum allowable vapor concentrations for 8-hour exposure, flammability ratings, flash-points, and explosive limits.

Electrolytic Copper Powder—Production Methods Employed by German Technicians. Anon. Metal Ind. (London) 71, No. 11, 226–227 (1947).
The electrolyte is acid copper sulfate solution without colloidal additions. For coarse powder, grades M and EM, the electrolyte contains 18 to 23 g/l copper and 150 to 160 g/l free sulfuric acid. For fine powder, grades FL and FFL, the concentrations are 8 to10 g/l and 150 to 160 g/l, respectively. The anode current density is 43 asf, and because the cathodes are only thin rods, the cathode current density is 280 asf. For making fine powder the electrolyte concentration is maintained by discarding 25 per cent of the volume every day and returning it to the refinery; for the coarser powder, 10 per cent is discarded every 4 to 7 days. The make-up for loss of electrolyte consists of condensate and sulfuric acid with 10 ml hydrochloric acid per cell. The voltage per cell is 1.2 to 1.5 volts. The copper sponge is removed from the cathodes every half hour by tapping their supports. This copper slurry is removed from the cell, filtered and washed with tap water until the wash water is neutral to litmus. It is then washed with dilute ammonia and with water until free from ammonia. Finally the slurry is centrifuged, dried, and sized.—L. H. SEABRIGHT.

A New Surface Treatment for Magnesium. A. L. Kohl and Herbert Waterman. Iron Age 161, 50–55 (January 22, 1948).
The new treatment described consists of anodizing the parts in a hot saturated sodium carbonate solution. A white crystalline coating is formed which is an electrical insulator and very resistant to abrasion. Corrosion tests indicate the value of the coating for corrosion resistance and also as a paint base. 10 ref.

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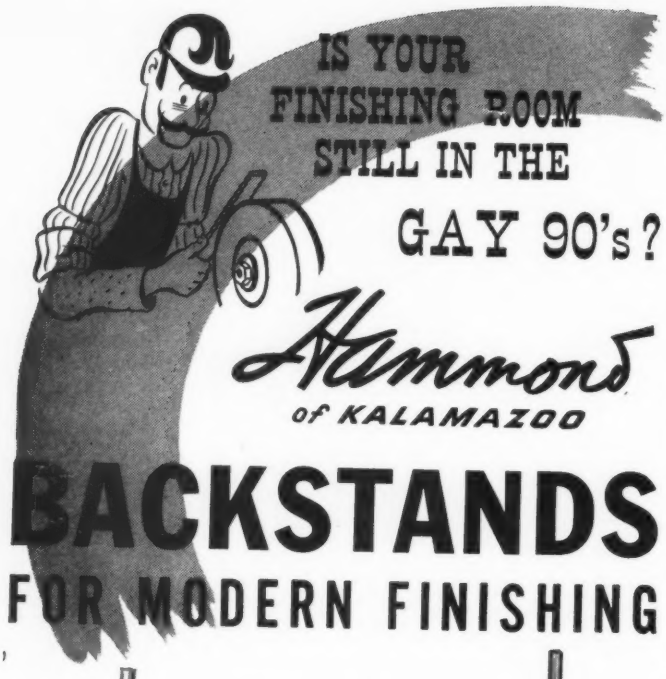

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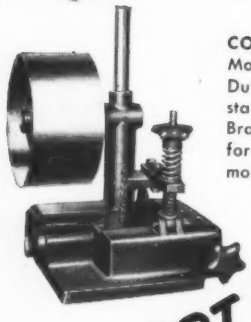

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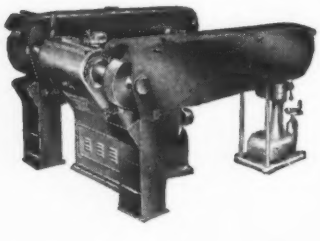

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Zinc Contamination. Methods of Purification of Bright Nickel Plating Solutions. H. D. Carter. Metal Ind. (London) **72**, No. 9, 170–173 (1948).

Since trouble due to zinc contamination is likely to be evident when it exceeds 0.050 g/l (50 ppm), the aim should be to keep it below 40 ppm. This may be performed by plating on dummy cathodes, precipitation treatments, or emptying the vat and filtering at more frequent intervals, thus ensuring that articles dropped into the vat are being subjected to attack by the solution for a much shorter period. All precipitation treatments rely on the adsorption of zinc on the surface of a precipitate and are followed by filtration. The precipitants in common use are basic nickel carbonate, nickel hydroxide, or ferric hydroxide, and are formed by raising the pH of the solution by means of caustic soda, lime, or nickel hydroxide, whichever is the most suitable for the particular nickel solution. The solution is warmed, and basic nickel carbonate, nickel hydroxide, or ferrous sulfate and peroxide are added; the solution is agitated and maintained at about 70° C for 1 to 3 hours. After filtration the pH is corrected, the solution cooled to working temperature, and plating commenced. Separation of zinc is virtually complete at a pH of 6.8. However, a considerable portion of the nickel is also lost, while the nickel/cobalt ratio remains sensibly constant at all pH values. Excellent working conditions would have resulted at pH 6.5 when the final zinc content was 6 ppm, while even at pH 6.1 the remaining zinc (41 ppm) was still below the danger limit of 50 ppm. A precipitation pH of 6.3 to 6.6 seems advisable, considering the practical difficulty of raising the pH to 6.8 and the resulting loss of nickel and cobalt.

Although a disadvantage of low current density treatment is that more cobalt is deposited at low current densities, it is far more efficient and reliable. In addition, no adjustment of temperature or pH is required. The main disadvantage is that considerable time is needed to clean a badly contaminated vat.—L. H. SEABRIGHT.

The Influence of Internal Stress on the Structure of Electrodeposits. M. R. J. Wyllie. J. Chemical Physics **16**, 52–64 (January, 1948).

The author's data on the properties of chromium electrodeposited from a standard chromic acid electrolyte are examined. It is shown that the data agree with the assumption that the preferred orientation found is the result of a slipping process, analogous to cold-working, which occurs during deposition when internal contractile stress reaches a certain critical value. The type of orientation found also agrees with the theory. It is believed that (111) orientation is to be expected generally for body-centered cubic metals electrodeposited in a state of contractile stress, while (110) or (100) is to be anticipated for the face-centered type deposited with the same type of stress. The orientations of a number of electrodeposited metals are

shown to agree with this hypothesis. Certain anomalies in the stress and orientation for silver, nickel, and aluminum deposits were studied experimentally, and the results explained on the basis of the above theory. In conclusion, the possible mechanism of internal stress formation in electrodeposits is examined. 37 ref.

The Treatment of Plating and Pickling Shop Wastes. E. W. Mulcahy. J. Electrodepositors' Tech. Soc. 22, 227–242 (1947).
Deals with methods of neutralizing acid from waste liquors and rinse water; the precipitation of chromium, copper, iron, etc.; the removal of cyanide in effluents; the construction of effluent treatment tanks of suitable acid-proof materials; the measurement of flow and recording of pH; the removal and scrubbing of nitrous oxide fumes from bright dipping plants; data on intake-air velocity for extractors; hard rubber as protective lining for tanks and fan casings; recovery of waste pickle liquors from industrial pickling plants; and furnishes a description of a plant for the crystallization of ferrous sulfate.

Polarographic Method for Control of Electrolytic Bath Compositions. III. D. A. Vyakhirev. Zavodskaya Laboratoriya **13,** 1167–1171 (October, 1947).
Shows the possibility of use of stationary lead electrodes instead of mercury for the amperometric titration of sulfate solutions, especially nickel plating baths. 11 ref.

Bonding Rubber to Die Castings. John Gerstennair. Die Castings **6,** 25–26, 51 (1948).
New phenolic and chlorinated rubber-type cements provide a method of obtaining adhesion to light metal alloys, die castings, powdered metals, carbon, plastics, etc., that cannot be successfully and economically brass plated. Almost all die cast metals can be brass plated; therefore, adhesion can be obtained by plating methods or by use of the new cement methods. The compound type of rubber is the determining factor in the selection of the adhesion method.—L. H. SEABRIGHT.

Use of Polarographic Method in Analysis of Zinc Plating Baths. I. A. Korshunov and L. N. Sazanova. Zavodskaya Laboratoriya **13,** 1172–1173 (October, 1947).
The polarographic technique for determination of zinc, aluminum, copper, iron, lead, and other substances which are present is described, and the results are compared with those obtained gravimetrically.

Dense and Porous Cathodic Deposits of Cadmium and Manganese. O. Kudra and E. Gitman. Zhurnal Prikladnoi Khimii **20,** 605–612 (July, 1947).
Decomposition voltages of cadmium and manganese salt solutions were investigated using a modified method. Two decomposition potentials were obtained in cadmium salt solutions: the lower one correspond-

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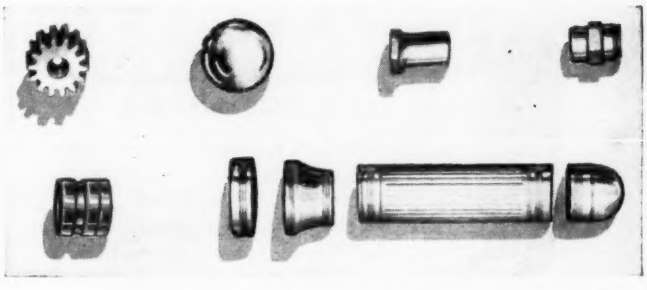

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ing to solid cadmium and the higher one, at an increased cathode current density, to porous deposits. Three decomposition potentials were obtained in manganese salt solution: the lower one corresponds to evolution of hydrogen, the intermediate one to deposition of dense manganese and the higher one to formation of porous deposits. The formation of porous cathode deposits should be ascribed neither to the action of hydrogen nor to the formation of crystallization centers and the growth of single crystals but to discharge of complex cations.

Variation of Resistance of Electrolytes with Form, Size, and Arrangement of Electrodes. III. Combination of Flat and Cylindrical Electrodes. V. P. Mashovets, V. V. Cherdyntsev, and M. V. Neustrueva. Zhurnal Prikladnoi Khimii **20**, 660–669 (July, 1947).
An equation is derived for the dependence of electrolyte resistance on interpolar distance for the above combination. Experimental measurements show that the equation is sufficiently accurate for technical purposes for small interpolar distances; for large distances, an empirical correction requiring determination of resistance for any one distance is necessary.

Zinc Determination; Absorptiometric Methods in Bright-Nickel Plating Solutions. D. F. Phillips and L. J. Holton. Metal Ind. (London) **72**, 69–70 (January 23, 1948).
Describes development of a rapid and precise method for determining amounts of zinc from 0 to 200 ppm.

Chrome Plating Outfit Proves Practical in Engraving Plant. Printing Magazine **72**, 94, 98, 101 (January, 1948).
This condensation of an article by William Perelstrus in recent issue of ESMA News Letter, published by Engraved Stationery Manufacturers' Association, outlines practical installation, operation, and control methods. Advantages are cited.

Blistering of Silver Plating at High Temperature. Carl F. Floe and M. B. Bever. Metal Progress **53**, 247–248 (1948).
Gives results of some experiments made to determine the cause of blistering on turbine and jet-engine parts. It was found that blistering required presence of oxygen or of water vapor at 800° and 1200° F. Tests at 1400° indicated that heating in nitrogen for a sufficient period removes hydrogen by diffusion while, on heating in air, oxygen is adsorbed and forms water vapor by reaction with hydrogen. Believes that hydrogen and oxygen embrittlement are misnomers which should be replaced by water-vapor embrittlement.

Contribution of the Electron-Diffraction Method to the Study of the Beilby Layer. R. Courtel.

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Metaux et Corrosion **22,** 157–167 (October, 1947).
A critical review in which the Beilby layer is defined as the amorphous, or vitreous, layer formed on the surface of a metal in the course of polishing. 60 ref.

Nitric Acid Versus Construction Materials. Chemical Eng. **55,** 233–234, 236, 238 (February, 1948).
Part I of a symposium in which typical materials of construction are evaluated for services involving nitric acid. Includes the following: "Iron and Steel", by A. W. Spitz; "Rubber Lining", by O. S. True; "Hastelloy", by C. G. Chisholm; "Durimet, Chlorimet", by Walter A. Luce; "Aluminum", by J. P. Balash and Ellis D. Verink, Jr.; and "Precious Metals", by E. F. Rosenblatt.

How To Finish Copper and Copper Alloys. R. W. Belfit, William E. Baulieu, E. W. Lovering, and B. H. McGar. American Machinist **92,** 95–106 (February 26, 1948).
Outlines methods and practices used in industry for deburring, polishing, buffing, cleaning, pickling, surface preservation, and decoration of copper; ordinary and special brasses; aluminum, silicon, phosphor and manganese bronzes; nickel silvers and copper-nickel alloys.

Report on the Evaluation of Surface Treatment of Steel Prior to Painting. Arnold J. Eickhoff. A. S. T. M. Bulletin 77–80 (January, 1948).
This is the final report of outdoor-exposure tests conducted by a Subcommittee of A. S. T. M. Committee D-1 on Paint, Varnish, Lacquer, and Related Products to determine the effect of cold phosphate-phosphoric acid pretreatments of steel surfaces which were subsequently painted. Results are tabulated, charted, and discussed.

Cleaning Surfaces by Non-Erosive Blasting. Joseph Albin. Metal Finishing **46,** 54–56, 61 (March, 1948).
Above method of cleaning, also known as seed or soft-grit blasting, promises interesting applications in the metal-finishing field. Describes its use in air lines maintenance for cleaning engine parts without causing abrasion of critical surfaces. Details of production methods, economy, and flexibility of the process are discussed.

Health Hazards of Metal Cleaning Compounds. Part III. P. M. Van Arsdell. Organic Finishing **9,** 18–28, 32 (February, 1948).
Covers halogenated hydrocarbons, methylene dichloride, chloroform, carbon tetrachloride, dichlorethylene, trichlorethylene, tetrachlorethylene, and miscellaneous solvents. Includes tables. 75 ref.

The Deposition of Pure Boron. Part III. A Flow Method for the Preparation of Boron Films on Iron Cylinders. H. I. Schlesinger and others. U. S. Atomic Energy Commission MDDC–1340 (November 14, 1944), 10 pp.
Describes and illustrates method and apparatus. Gives experimental data on effect of partial pressure of diborane and hydrogen, temperature of deposition, nature of the surface, and rate of flow on nature of the deposit.

Electrodeposition of Lead from the Ethylbenzenesulfonate Bath. Frank C. Mathers and John F. Suttle. J. Electrochem. Soc. **93,** 47–48 (February, 1948).
A cheaper or more satisfactory lead plating and refining bath than the usual ones with fluoborate or fluosilicate would be desirable. Many different addition agents were tried, but none gave as good deposits as could be obtained from corresponding lead fluosilicate baths. The best results were with beta-naphthol and glue or goulac, or both.

An Electrolytic Thickness Tester for Plated Metal Coatings. Howard T. Francis. J. Electrochem. Soc **93,** 79–83 (March, 1948).
Describes a device based on anodic dissolution of a defined area of the plated metal and using the current-time product as a measure of the thickness. Successfully measured coatings include tin, zinc, lead, cadmium, copper, chromium, silver, gold, and brass on steel and tin, zinc, lead, and chromium on brass or copper. 0.000030 inch of tin on steel can be measured with an accuracy of ±2 per cent.

The Electrochemistry of Indium. Therald Moeller and B. S. Hopkins. J. Electrochem. Soc. **93,** 84–93 (March, 1948).
A review which includes electrical characteristics, electrodeposition of the metal, and electrochemical properties of indium compounds. 71 ref.

The Metallography of Electrodeposited Surfaces. The Physics of Grinding and Polishing. II. Changes in Metal Surface Character During Machining, Grinding, and Polishing. A. T. Steer. Electroplating **1,** 153–165 (February, 1948).
Illustrated by numerous photomicrographs.

Polishing—Its Role in the Metal Finishing Industry. W. L. Pinner. J. Electrodepositors' Tech. Soc. **23,** 95–100 (1948).
A good discussion of the relationships between the condition of the base metal (steel), the method of polishing, the type of nickel plate, possible subsequent buffing of the plate, and the ultimate corrosion resistance of the article.—LYMAN B. SPERRY.

Metallic Coating of Wire. Herbert Kenmore and Frank L. Durr. Wire and Wire Products **23,** 135–138 (February, 1948).

Reviews methods previously developed and describes a new method, the Kenmore process, for electroplating wire of various metals and alloys with different metals by a continuous, automatic process. Plating of nickel coated low-carbon steel wire is described in detail, and present and potential applications are outlined.

Mechanism of Electrodeposition of Nickel. I. Ultramicroscopic Investigation of the Process. II. Role of Hydrogen in the Process of Electrodeposition of Metal. G. S. Vozdvizhenskii. Zhurnal Prikladnoi Khimii **20,** 813–822 (September, 1947).
In Part I it is shown that, contrary to the assumptions of other investigators, no colloidal solutions or suspensions of basic compounds are formed in the region near the cathode. The mechanism of formation of basic nickel compounds on the cathode is explained. In Part II, the effect of hydrogen on structure and properties of the deposits is described. 26 ref.

The Relation of Electrodeposition to Electrochemistry. G. E. Gardam. J. Electrodepositors, Tech. Soc. **23,** 1–8 (1948).
Points out that knowledge of theoretcial electrochemistry has been much less helpful in the improvement of electrodeposition methods than would, at first sight, be expected. Discusses the reasons for this fact and ways in which more correlation may possibly be achieved in the future.

Danger of "Masked Pores" and Methods for Their Determination. A. Glazunov. J. Electrodepositors' Tech. Soc. **23,** 9–13 (1948).
In certain cases, pores in electrodeposits are bridged by forming masked pores, which are hard to detect, but which represent points at which failure will soon occur. Describes an electrographic method of detection in which the specimen is made the anode, an aluminum plate the cathode, and a sheet of filter paper or cellophane moistened with a suitable reagent inserted between them. Appearance of colored spots after a delay of the order of half a minute is said to indicate the presence of masked pores.

Chromated Protein Films for the Protection of Metals. Abner Brenner, Grace Riddell, and Robert Seegmiller. J. Electrochem. Soc. **93,** 55–62 (March, 1948).
Describes process developed for protecting steel, zinc, aluminum, and brass from corrosion. Casein, albumin, or gelatin is applied to the metal surface by dipping. The film is impregnated with chromate, which acts as an inhibitor of corrosion and hardens the film, by adding the salt to the protein solution or by separate immersion. These films may be useful for the protection of certain metals in mildly corrosive atmospheres.

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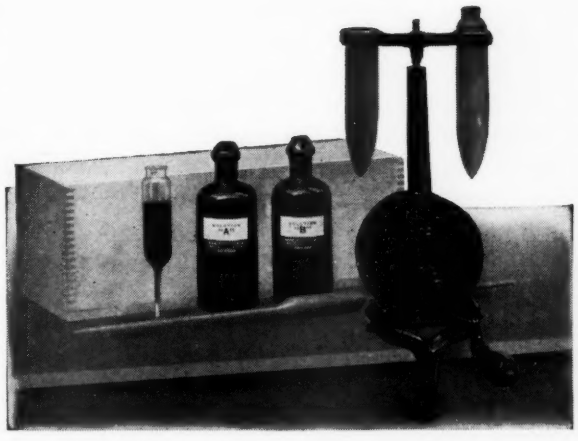

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ing. N. D. Tomashov. Vestn. Inzhen. Tekhn. **1946** 59–65; Met. Abstracts **15,** 238 (February, 1948).
The electrolytes used for anodic oxidation are divided roughly into three groups: (1) electrolytes which have no effect on the freshly formed oxide film (solutions of nitrates, bicarbonates, borates, phosphates, and chromates); (2) electrolytes which slightly dissolve the film (chromic, oxalic, and sulphuric acids, bisulphates, alums, and permanganates); (3) electrolytes which readily dissolve the film (alkali hydroxides, hydrochloric acid, and chlorides). The thickness and the density of the oxide film are largely determined by the electrolyte in which it is formed. Films of appreciable thickness (1–100 and in certain cases up to 600μ) can be produced in electrolytes of group (2) by properly choosing the concentration, temperature, current density, nature of current (AC or DC, potential, etc.), time of anodizing, etc. The effects of these factors, individually and combined, are discussed. Anodically oxidized aluminum has properties which make it desirable in the construction of internal-combustion motors. For this purpose, oxide films 50 to 500 μ thick are required. The films are porous to an extent variable within certain limits. The pores can be filled with chromates to impart corrosion-resistance. They can also be filled with pigments to color the surface, with silver salt to photo-sensitize it, or with oil or colloidal graphite to impart anti-friction properties to the surface. The oxidized film adheres very strongly to the aluminum base. The alumina film is resistant to high temperature, very hard and wear-resistant; its heat conductivity is established to be 0.001 to 0.003 calories per centimeter second, and its coefficient of heat reflection at 150 to 200° C is 80 compared with 100 for a black body. The advantages of using alumina films on pistons, cylinder heads, cylinder linings, bearings, and other parts are discussed.

Rectifiers for Electroplating—Part V. Louis W. Reinken. Metal Finishing **46,** 57–61 (March, 1948).
Discusses automatic stabilization, voltage and current stabilization, theory of stabilizer design, theory of automatic current stabilization, stabilization of rectifier banks, and economic considerations.

Surface Active Agents as Applied in Non-Ferrous Metal Technology. J. Koerner. National Lead Company Research Laboratories, 9 pp.
Includes theoretical and practical considerations of the above as applied to soft-solder fluxes, etching solutions, cleaning solutions, and other applications.

Anodic Oxide Coatings. The Influence of Sealing Treatments on Protective Value. L. Whitby. Metal Ind. (London) **72,** 400–403 (1948).
The chromic acid process of Specification D.T.D. 910B provides good protection compared with that obtained with unsealed sulfuric acid anodized coatings, but when the latter are sealed, even by boiling water, their protective value is almost twice that of the chromic acid anodized coatings. The high efficiency of potassium bichromate sealed coatings is not changed by the substitution for the 30-minute process of the 4-minute rapid process at higher pH of Tomashov and Tyukina (See Abstracts in THE MONTHLY REVIEW for November, 1947). Excellent results are also obtained with zinc chromate impregnation. Sealing with cobalt or nickel acetate did not reveal any marked difference between the two salts, both solutions being considerably more effective than boiling water but less effective than dichromate. For sealing, sodium silicate solutions can be equal to nickel or cobalt acetate solutions, but the silicate should apparently possess a molecular ratio of SiO_2 to Na_2O of not less than 2.65:1. Porous castings after sulfuric acid anodizing and sealing in boiling water often develop corrosion spots, particularly if stored in atmospheres of high humidity. Tests in atmospheres of 95 per cent relative humidity have shown that dichromate sealing, contrary to hot water sealing, prevents formation of corrosion spots and that this treatment can be applied effectively to many dyed coatings, particularly those of saturated colours, without affecting them. In some cases, however, the dichromate causes a colour change and the acetates should then be used.—L. H. SEABRIGHT.

Contribution to the Theory of Electrophoretic Deposition. Ch. Biguenet. Le Vide-Technique-Applications **2,** 304–307 (1947).
Presents certain observations concerning the activity of suspended particles during electrophoretic deposition which are believed to be of great importance. Further study is planned.

Anodising and Dyeing; Practical Experiences and Final Conclusions. K. E. Langford. Electroplating **1,** 215–218 (March, 1948). (A condensation.)
Describes technical difficulties encountered in setting up a shop for anodizing and dyeing of aluminum and its alloys, and their solutions. Emphasis is on practical aspects, especially of the dyeing process, in which a wide variety of colors is applied.

Production of Electro-Formed Moulds (for Plastics and Die Castings). P. Spiro. British Plastics **20,** 124–129 (March, 1948); Electroplating **1,** 256–266 (April, 1948).
Outlines the process; discusses type of mold, the master material, metallizing of the master, and selection of the metal for deposition. Choice was among nickel, iron, cobalt and chromium. All but the first were ruled out on various grounds. Composition of the bath; adhesion, pitting, and stress problems; alternative baths; throwing power; hardness and ductility of the deposit; corner weakness; backing and polishing the shells; and analysis for traces of cobalt are other topics treated. 11 ref.

Some of the Effects of Cadmium, Zinc, and Tin Plating on Springs. John R. Gustafson. American Society for Testing Materials, Advance Print AP5, 1947, 21 pp.

Gives data obtained from fatigue and salt-spray tests.

The Effect of Plating Conditions on the Structure of Thick Chromium Electrodeposits. J. J. Dale. Sheet Metal Ind. **25**, 531–539, 546 (March, 1948).

Gives results of investigations of the microstructure of electrodeposited chromium, its relation to plating conditions, and its connection with the channel network produced by surface etching of deposits; of a few experiments on the effect of heating on the microstructure of electrodeposits; and of some attempts to identify minor constituents in the structure. Numerous photomicrographs. 16 ref.

Transmission of Cracks from Plate to Underlying Metal. F. D. Rowe and J. B. Dance. Metal Progress **53**, 537–538 (April, 1948).

Describes and illustrates an example of fatigue failure of an exhaust-valve stem overlaid with chromium. Photomicrograph shows that pre-existing stress cracks in the plate are linked with fatigue cracks in the base metal. The authors conclude that hard chromium is an unsatisfactory coating for components operating under fluctuating stresses.

Nitric Acid Versus Construction Materials. Chemical Eng. **55**, 219–220 (April, 1948).

Part III of a symposium in which construction materials are evaluated for nitric acid services. Consists of the following brief articles: "Worthite", E. T. Collinsworth, Jr.; "Nickel, Nickel Alloys", W. Z. Friend; and "Protective Coatings" (anonymous). Refers to plastic materials.

Present Day Need for the Determination of Weight of Nickel Deposit. J. M. Zander. Better Enameling **19**, 6–8 (March, 1948).

The value of a nickel dip in preparation of steel surfaces for vitreous enameling has been clearly demonstrated. It has been observed that weights of nickel deposits vary over a wide range, especially when using non-uniform steels. Recommends determination of the weight of deposit as a control procedure for achieving higher quality and fewer rejections. Reprints volumetric procedure from January, 1945 issue.

A Theory for the Mechanism of Chromium Plating; A Theory for the Physical Characteristics of Chromium Plate. Cloyd A. Snavely. Electrochemical Society, Preprint **92-35**, 1947, 39 pp.

Describes structural characteristics of chromium plating. New fundamental data are presented on crystal structure of chromium deposited from chromic acid solutions.

NEW RESEARCH REPRINTS

"Stripping of Copper from Various Base Metals," by F. C. Mathers and E. C. Martin. A. E. S. Research Report Serial No. 7. Price 70c.

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"Adhesion of Electrodeposits," by A. L. Ferguson. A. E. S. Research Report Serial No. 8. Price $1.00.

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By GEORGE B. HOGABOOM
Consultant, New Britain, Conn.

No. 2,434,191, January 6, 1948—Removing Organic Impurities from Copper Cyanide Electroplating Baths —H. L. Benner and Robert R. Bair, assignors to E. I. du Pont de Nemours & Company, Inc.

When electroplating metals from alkaline plating baths, for example, cyanide plating baths, the baths commonly become contaminated with organic materials from various sources.

We have discovered that organic compounds can be efficiently and completely removed from an alkaline electroplating bath or rendered innocuous by adding to the bath a soluble salt of an alkaline earth metal hydroxide. For the purpose of this invention, the term "alkaline earth metal" in the specification and in the appended claims includes magnesium, as well as calcium, barium and strontium.

EXAMPLE I. A copper cyanide plating bath was made up containing approximately:

	oz/gal
Copper cyanide	8
Free cyanide (NaCN)	0.5
Sodium hydroxide	4
Sodium carbonate	3.8

This bath was contaminated by adding 0.25 oz/gal of greasy buffing compound. Deposits were then made at 30 asf and showed typical blotched, irregular effect resulting from organic contaminants. After treatment with 1 oz/gal of magnesium chloride and filtration to remove magnesium hydroxide, deposits were again bright at a current density of 30 asf.

EXAMPLE II. A bright copper cyanide plating bath in satisfactory operation to produce bright plate contained:

	oz/gal
Copper cyanide	17.73
Free cyanide (NaCN)	0.5
Sodium hydroxide	3.7
Sodium carbonate	6.26

This bath was contaminated by adding small amounts of buffing compound, oil and grease, boiled for four hours and filtered. The bath then was placed in operation, and the resulting copper plate was stained and mottled, exhibiting the typical effects of organic contaminants. The bath was treated by adding 8 oz/gal of calcium chloride ($CaCl_2$) which was an excess of approximately 1.73 oz/gal over that required to precipitate all carbonate in the bath. The resulting precipitate of calcium carbonate and hydroxide was filtered off and the bath replaced in operation. Good bright plate was obtained from the purified bath in a current density range of 10 to 100 asf.

EXAMPLE III. An operating conventional bright zinc bath, which produced satisfactory bright zinc plate contained:

	oz/gal
Zinc cyanide	10
Sodium cyanide	5
Sodium hydroxide	10

This bath was contaminated by the addition of a greasy buffing compound and thereafter the resulting plate was dull at current densities of 10 asf and 70 asf. After the addition of 2 oz/gal of magnesium sulfate and filtering off the precipitated magnesium hydroxide, the bath produced good bright plate at aforesaid current densities.

Our method is applicable to all alkaline electroplating baths, wherein the degree of alkalinity is sufficient to cause the desired precipitation of alkaline earth metal hydroxide. Thus, for example, our process is adapted for purification of various cyanide baths for plating metals such as zinc, copper, brass, cadmium, silver, gold and bronzes (tin-copper alloys), and also for other alkaline plating baths, e. g., for plating zinc and tin (stannate and stannite baths). If the alkalinity is not sufficiently great to precipitate the required amount of alkaline earth metal hydroxide, we may add sufficient alkaline reagent such as an alkali metal hydroxide or an alkali metal salt, e. g., sodium or potassium cyanide, tetraborate, carbonate, or the like, which will impart the required alkalinity to the bath. In most alkaline plating solutions, such addition of alkali is unnecessary.

CLAIM 1. The process for removing deleterious organic compounds from a used electroplating bath containing hydroxyl ions and carbonate which comprises precipitating magnesium hydroxide in said bath by adding a soluble magnesium salt to said bath and replacing the acid radicals of said magnesium salt with hydroxyl radicals substantially without precipitating magnesium carbonate therein.

6 claims, 4 cited references.

No. 2,442,195, May 25, 1948—Cleaning and Electroplating Process—J. F. Clenny, assignor to General Electric Company.

Heretofore metal objects which were coated with oil or grease, and also with rust or other oxides, have been subjected to a succession of independent stripping operations in order to remove undesired surface contamination.

In accordance with my invention I have provided a procedure comprising the combination of a plurality of electrolytic steps carried out successively in a single fused electrolyte in which the metal object to be cleaned functions alternately as anode and cathode. As a consequence, the treatment of the metal is simplified, shortened in time, and made more efficient.

CLAIM 1. The process of cleaning and copper plating the surface of a ferrous metal article which comprises immersing said article in a fused caustic soda

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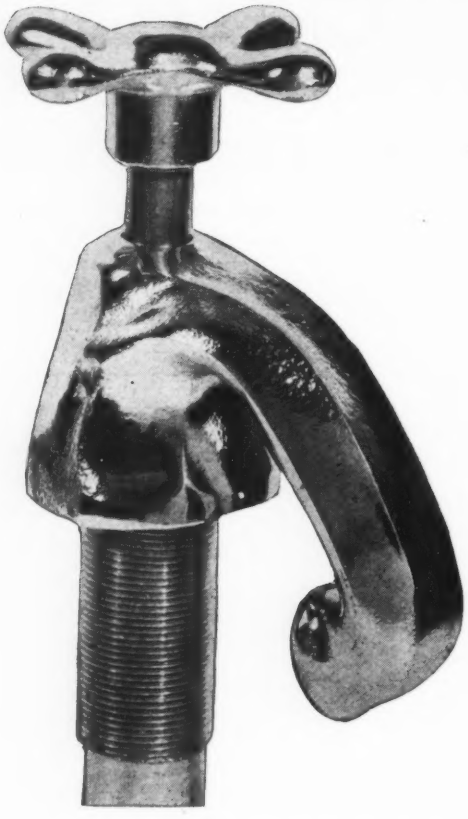

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bath containing from one to ten per cent of copper oxide and heated to a temperature of from 400 to 500° C and while the article is continuously immersed in said bath passing a direct current through said bath and article to subject the article to the following series of electrolytic operations: (a) as the anode for about one minute at a potential of about 3 to 6 volts and a current density of from 150 to 200 amperes per square foot to remove organic matter from the surface of the article; (b) as the cathode at the same current density for about seven minutes until adherent rust and scale are removed; (c) as the anode at a current density about one-tenth the value employed in steps a and b to remove spongy copper deposited during step b; and (d) as the cathode at a current density of about 25 amperes per square foot to deposit on the surface of said article a homogeneous coating of copper.

References cited: U. S. Patents 1,004,673; 1,417,896; 1,600,355; 1,795,512; 1,909,149; 2,042,800; 2,134,457; 2,311,139; 2,327,676; 2,366,477; 2,395,694. British Patent 425,385.

No. 2,442,592, June 1, 1948—Electrolytic Polishing of Stainless Steel—A. L. Feild, assignor to American Rolling Mill Company.

CLAIM 3. The art of electropolishing a chromium-nickel stainless steel product which comprises immersing the product to be polished in a bath containing by volume 80 per cent or more of concentrated aqueous nitric acid (sp. gr. 1.40–1.42) and the remainder water, and while maintaining the bath at a temperature below 25° C passing only alternating current through said bath between the product and a cooperating electrode immersed therein, the current density being at least ½ to 12 amperes per square inch of product surface.

5 claims, 1 figure.

References cited: U. S. Patents 2,040,618; 2,424,674. British Patent 530,041.

Nos. 2,442,628–2,442,629, June 1, 1948—Recovery of Nickel from Idle Nickel Electroplating Baths and the Production of an Iron-Nickel Master Alloy—A. Wesley and E. J. Roehl, assignors to International Nickel Company, Inc.

The problem of recovering nickel from idle nickel electroplating baths is one for which those skilled in the art had no solution prior to a comparatively recent date (October, 1943).

We have found that nickel can be recovered economically from idle electroplating solutions by electrodeposition as an iron-nickel alloy suitable for use in steel making and similar metallurgical operations.

The solution contained nickel in the following form and amounts:

	oz/gal	*g/l*
Nickel sulfate	40	300
Nickel chloride	6	45

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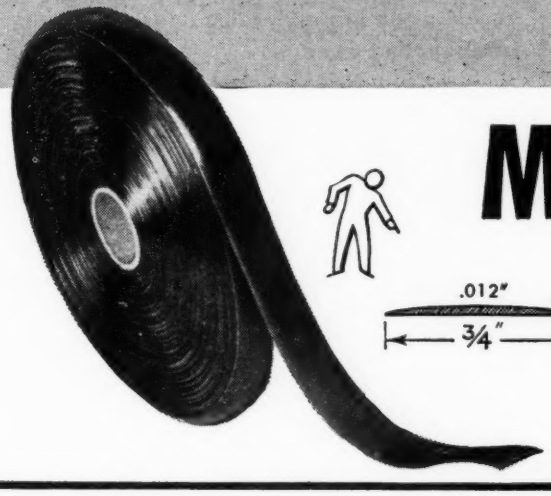

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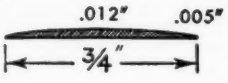

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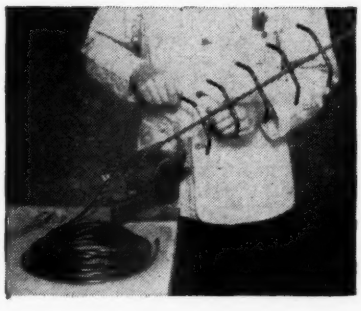

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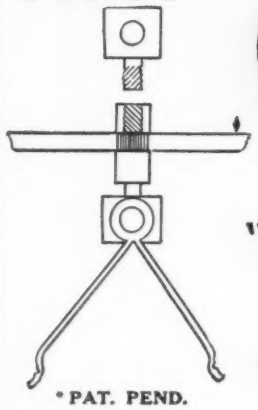
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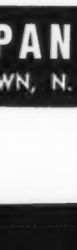
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Total nickel content	10	75
Boric acid	4	30

Nickel was recovered from a bath having the foregoing composition, employing mild steel anodes and a temperature of about 120° F. Two anodes, 3 x 6 x 1/8 inch and a steel cathode having an area of about 0.14 sq.ft. was employed. The anode-cathode spacing was 2.5 inches. The *p*H of the solution was maintained between 5.0 and 5.6 by the addition of sulfuric acid at suitable intervals. The cathode current density of about 20 asf was employed and maintained until 70 per cent of the nickel originally in the bath had been removed as was determined by analysis. During this period a total of about 300 ampere-hours per gallon of solution had been passed through the cell. During the next hundred ampere-hours little nickel was recovered. The current density was then lowered to about 5 asf of cathode area and nickel deposition reoccurred. When about 90 per cent of the nickel present in the original solution had been recovered, the rate of nickel removal by electrodeposition became too low to be economically practical and electrodeposition was terminated.

CLAIM 3 (of No. 2,442,628). A process for recovering nickel by electrodepositing a mass of iron and nickel electroplating electrolytes without substantially replenishing the nickel from other sources as nickel is recovered which comprises passing an electric current between an anode of ferrous material substantially devoid of nickel and a cathode immersed in a buffered, aqueous nickel-containing electrolyte having a *p*H between 4.0 and about 5.6, employing a current density of about 20 to about 35 asf until the nickel content of the electrolyte is reduced to about 3 oz/gal without substantially replenishing the nickel from other sources as nickel is plated out of the electrolyte, thereafter employing a different current density of about 5 asf without substantially replenishing the nickel of the electrolyte whereby the efficiency of nickel recovery is markedly increased, and continuing the deposition at said different current density until about 85 per cent to about 90 per cent of the nickel originally present in said aqueous electrolyte has been electrodeposited at the cathode as a nickel-iron deposit.

5 claims, 1 figure in No. 2,442,628; 4 claims, 1 figure in No. 2,442,629.

References cited in No. 2,442,628: U. S. Patents 788,064; 969,773; 2,051,433.

Trans. Electrochem. Soc. **58**, 357–372 (1930); Z. Elektrochem. **40**, 341–343 (1934); **41**, 596–597 (1935).

No. 2,443,119, June 8, 1948—Process of Producing Predetermined Metallic Patterns—Milton D. Rubin.

CLAIM 2. The method of producing a predetermined pattern of metallic members secured to an insulating base which comprises preparing an insulating base member having an electrically conducting surface with a coating of a photochemically active material

normally soluble in a selected developing fluid, said material being adapted to be changed into a form insoluble in said developing fluid when subjected to actinically active radiations, shining actinic radiations through a negative onto said coating, said negative having a predetermined pattern of transparent and opaque portions, whereby said coating, where it is subjected to said radiations shining through said transparent portions, is changed into insoluble form, covering said coating with a film of greasy ink, dissolving the remaining soluble coating by said developing fluid to expose the underlying conducting surface, covering the remaining surfaces bearing the greasy ink with powdered insulating plastic material having a melting point substantially below the melting point of said insulating base, melting said powdered insulating material, allowing said melted insulating material to reharden, plating metal upon the exposed conducting surface, and removing the last-named insulating material, the greasy ink, the insoluble portions of said coating and the conducting surface beneath it to expose the underlying insulating base member, leaving said predetermined pattern of metallic members secured to said insulating base member.

2 claims, 6 figures.

References cited: U. S. Patents 653,024; 1,563,731; 1,942,686; 1,963,834; 2,031,185; 2,083,249; 2,279,567. British Patent 269,729.

No. 2,443,599, June 22, 1948—Electroplating Method Employing Pulsating Current of Adjustable Wave Form—A. E. Chester, assignor to Poor & Company, Chicago, Ill.

An object of my invention is to produce bright adherent metallic deposits of good quality at high electroplating rates.

Another object is to employ pulsating current in electroplating to increase the possible plating rate and to have the instantaneous value of the pulsating applied voltage at all times positive.

A further object is to provide means for adjusting the magnitude of the alternating current component which is applied to a given direct current voltage to produce a desired plating result.

Another object is to provide a method of plating zinc which can effectively use zinc oxide containing impurities and known as "secondary" zinc, which is commercially readily available at a comparatively low price, instead of requiring the pure zinc anode which has heretofore been necessary.

A preferred formula:

Sodium cyanide	75 grams per liter
Zinc oxide	45 grams per liter
Sodium hydroxide	15 grams per liter
Lauric alcohol sulfonate	1/10 of 1% by weight
Calcium gluconate	10 grams per liter

CLAIM 2. In electroplating of work employing an aqueous bath containing dissolved salts of the plating metal and an anode and wherein the work is the

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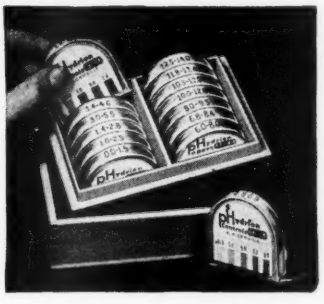

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cathode, the method of obtaining rapid clean deposition which consists in applying to the cathode with respect to the anode a pulsating direct current voltage whose instantaneous value is always positive, said pulsating voltage having an unvarying direct current component and further having a sinusoidal alternating current component, the instantaneous peak value of the alternating component considered separately being at least half of the value of the unvarying direct current component and the lowest instantaneous value of the said pulsating voltage at the negative alternating peak being between 0.5 and 1.5 volt, said direct current component having a voltage not substantially higher than 24 volts and said alternating current component having a frequency within the range of from about 25 to 60 cycles inclusive.

7 claims, 6 figures.

References cited: U. S. Patents 1,388,874; 1,755,479; 1,918,605; 2,063,760. British Patent 414,939. German Patent 464,709.

Metal Industry, April 19, 1929, pp. 396–398. Trans. Faraday Soc. **18**, 102–111 (1922); **24**, 348–358 (1928).

No. 2,443,600, June 22, 1948—Electroplating Method and Electrolyte—A. E. Chester, assignor to Poor and Company, Chicago, Ill.

One of the objects of the present invention is to provide a single additive composition which will control carbonate content in cyanide plating baths, improve the appearance and brightness of the plate, improve the throwing power of the bath.

Still a further object is to provide a plating solution containing the aforesaid substantially insoluble addition agent which may be advantageously used with an ordinary plating source of direct voltage, but which is especially useful with plating currents of abnormal wave form such as are obtained by superimposing an alternating current component on a direct current component.

CLAIM 3. The process of electrodepositing zinc . . .

CLAIM 4. The process of electrodepositing cadmium . . .

CLAIM 5. The process of electrodepositing copper . . .

CLAIM 13. In electroplating work employing an aqueous bath containing dissolved salts of the plating metal and an anode and wherein the work is the cathode and bath-soluble carbonates are formed during the electroplating operation, the method of obtaining rapid clean deposition which consists in applying to the cathode with respect to the anode a pulsating direct current voltage whose instantaneous value is always positive, and maintaining calcium gluconate as an addition agent in suspension in said bath, the quantity of said calcium gluconate being effective to react with and precipitate said bath-soluble carbonates as insoluble calcium carbonate.

16 claims.

References cited: U. S. Patents 694,658; 1,388,874; 1,755,479; 1,918,605; 2,063,760. British Patent 414,939.

Metal Industry, April 19, 1929, pp. 396–398; Trans. Faraday Soc. **18**, 102 (1922); **24**, 348–358 (1928); Proc. Royal Soc. **A112**, 259 (1926).

No. 2,443,651, June 22, 1948—Process of Electroplating on Tungsten—J. J. Cannizzaro, assignor to Westinghouse Electric Corporation.

For many applications, it is desired to produce a tenaciously adherent electroplated coating of some metal on tungsten sheets, wires and other bodies of the tungsten. For example, it may be desirable to soft solder a tungsten wire or the like to a base composed of copper or other metal. Tungsten, however, is not considered to be soft-solderable. However, an electroplated coating of nickel on the tungsten will permit effective soft soldering to be accomplished. Numerous other applications are facilitated if an electroplated coating of some metal, such as nickel, copper, tin, or the like, can be electroplated on the tungsten with good adherent bond being present.

It has been discovered that tungsten may be electroetched to provide for a clean surface having such characteristics that metals may be electroplated thereon to produce tenaciously adherent coating.

CLAIM 3. In the process of plating nickel on a tungsten member, the steps comprising, applying to the tungsten member an aqueous solution having from 5 per cent to 50 per cent hydrofluoric acid, passing an alternating current at 5 volts through the tungsten member while it is in contact with the aqueous solution for a period of from one to two minutes to etch the member, removing the tungsten member from the aqueous solution, applying to the tungsten member a plating solution from which nickel may be electrodeposited, passing a direct current through the member and the plating solution to plate nickel on the tungsten member.

Claims. 3

References cited: U. S. Patents 1,607,582; 2,115,005. Webster's New International Dictionary, 22nd ed., 1940, pp. 1715–1716.

No. 2,444,845, July 6, 1948—pH Responsive Glass Electrodes—G. A. Perley, assignor to Leeds & Northrup.

CLAIM 5. A glass electrode having a sodium error not exceeding 1 *p*H at 2 N sodium at 12.6 *p*H at temperature 25° C to 35° C whose voltage/*p*H characteristic is reproducible throughout the range 0 *p*H to 14 *p*H, and whose glass network structure is represented by the prefusion mixture consisting of silica with LiO_2 and at least one of the oxides of the group consisting of CsO, RbO, Na_2O, K_2O, and with at least one of the oxides of the group consisting of CaO, BaO, SnO, and high ratio of oxygen to silicon in said structure provided by inclusion in aforesaid mixture of at least one of the oxides of the group consisting of TeO_3, P_2O_5, TiO_2, ZrO_2, As_2O_5, Cb_2O_5, Ta_2O_5, ThO_2, B_2O_3 and the rare earth metal oxides.

8 claims, 7 sheets.

References cited: U. S. Patent 2,311,977.

Dole, "Glass Electrode", 1941, pp. 69, 74, 75, 89, 90.

Mirsky et al., J. Biol. Chem. **81**, 582 (1929).

No. 2,445,372, July 20, 1948—Process of Copper Coating Stainless Steel—Herbert W. Trenbath, assignor to The American Steel and Wire Company.

CLAIM 1. The process of electrochemically coating stainless steel wire with copper without externally applied electric current, which comprises moving the stainless steel wire through an aqueous solution of copper sulfate as electrolyte and maintaining the wire while immersed in said solution in contact with plain carbon steel bodies being in direct contact with each other at spaced apart points within said solution, thereby forming a galvanic couple between the stainless steel wire and the plain carbon steel bodies, said contact being maintained until said wire is coated with copper from the electrolyte.

1 claim, 5 figures.

References cited: U. S. Patents 506,957; 1,397,514; 1,582,617; 1,766,201; 2,293,810; 2,358,104; 2,359,095; 2,363,973.

NOTE: The book, "The Plating of Zinc Alloy Die Castings", reviewed by Dr. Read in the July issue, is being distributed by Machinery Publishing Company, Ltd., National House, West Street, Brighton 1. England.

Increase Production!

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"Increased Production" is no idle boast with Nobles Centrifugal Dryer. Scientific engineering with a knowledge of your drying problems has produced a modern air extractor feature surprisingly thorough and speedy in operation. A powerful fan which is built right into the assembly sucks moisture laden air out of the machine and dry air in at a rate that makes the drying cycle but a matter of seconds.

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NEW ELECTROLYZING UNITS

Can Cut your Power Costs

Model SA150D
0/1 Volt — 50 Ampere
Size:
15" wide x 9" deep x 16" high
Weight 75 lbs.

New Richardson-Allen Selenium Electrolyzing Rectifiers are designed for 24-hour continuous cleaning of

- Bright Nickel Solutions
- Dull Nickel Solutions
- Hot Nickel Solutions
- Watt Nickel Solutions
- and eventually acid Copper Solutions

They can be operated by connecting to a small auxiliary tank and pump. Your solution is then pumped continually to this small tank cleaned and pumped back to the main tank.

For overnight or off-working hours, connect this unit to your main tank. Plugs into normal 115V single phase light circuit outlet.

SPECIAL FEATURES

- 24 hour continuous operation
- Absolutely no maintenance
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Rectifier Division
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Available in three sizes

SA150D 0/1 Volt— 50 Ampere
15" x 9" x 16"

SA1100D 0/1 Volt—100 Ampere
15" x 12" x 16"

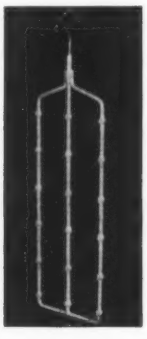
SA1200D 0/1 Volt—200 Ampere
16" x 16" x 24"

RICHARDSON-ALLEN SELENIUM RECTIFIERS

Equipment & Supplies

E—129. Plastic Coating Material—Enthone, Inc., 442 Elm Street, Dept. P, New Haven, Conn., has announced the development of a new liquid plastic material, Enthonite 101, for coating plating racks, tanks, work holders, and acid dipping baskets. Supplied as a viscous liquid containing 100 per cent solids, it is applied by dipping over a primer coat to produce coatings varying in thickness from ⅛ to ¼ inch, and baked at 350° F or higher for a short period of time.

No loss is experienced because there are no solvents to evaporate and all drippings can be reclaimed and reused. The

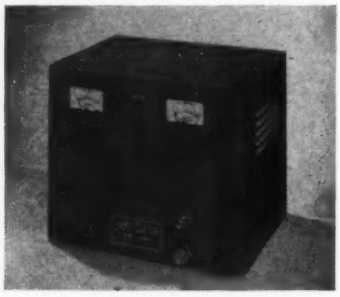


coatings are stated to have very high resistance to all types of inorganic solutions, particularly plating solutions, including chromium plating solutions. Considerable saving in dragout of solution is claimed because the surface is so glossy that solutions do not readily wet it. The coatings are tough and resilient and will not chip even on rough abuse. Racks coated with Enthonite 101 are being used in full automatic plating cycles involving the use of strong alkali cleaner, strong acids, acid or alkaline plating solutions and chromium plating solutions. The resistance to attack or absorption by chromic acid is claimed to be an outstanding feature of this product.

Repair of the coatings for replacement of hooks is done easily by the use of a patching cement and a radiant energy heat lamp. For further information, use Reader Service Card.

E—130. Low Amperage Selenium Rectifier—A new 10 ampere, 8 volt Vari-Plater Model No. A-10, is now being manufactured by the Lewis Electrical Manufacturing Company, 1943 Walton Avenue, New York 53, N. Y.

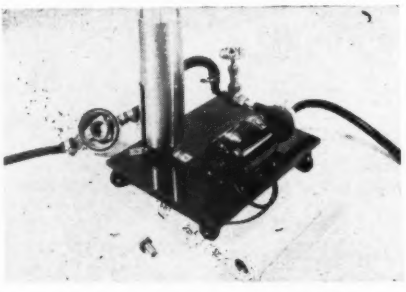
Some of its features are: DC voltage variable from zero to maximum; several units can be combined to raise voltage or amperage; no warm-up period; conservative rating; construction of standard,



replaceable parts. For further information, use Reader Service Card.

E—131. Small Filter Unit—Sethco, 105–107 150th Street, Jamaica 4, N. Y., has announced a new low-priced, small filter unit, adaptable to either periodic or continuous filtration. The unit is constructed of stainless steel throughout and is said to be suitable for filtering all the common plating baths. Because there is only a small volume of liquid contained in the filter, all of which is recoverable, the unit has definite advantages for use with precious metal baths.

Only three minutes are required to set it up, and 20,000 to 40,000 gallons of solution can be filtered through each filter tube before it needs changing. The filter tube is made of specially processed cotton yarn wound around a stainless steel core and requires no filter aids to remove all particles 8 to 10 microns, and the greater proportion of particles down to 1 micron. For removal of organic matter, grease, and oil from solutions simply place a tube in the filter case, pour activated granular charcoal between the tube and the filter case, lock the filter with the nut, and start filtering. No filter aid, powdered charcoal, slurry tank, or wait-

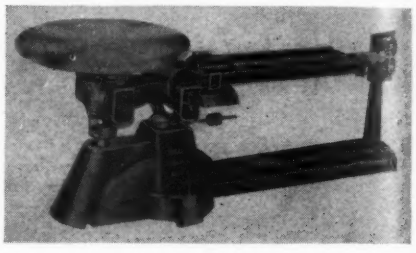


ing for clear effluents are required. A maximum filtration rate of 100 gallons per hour is recommended for greatest efficiency, although filtration rates as high as 250 gallons per hour are possible. The filtration rate can be adjusted to any desired flow between 0 and 250 gallons per hour with the stainless steel valve.

The unit comes complete with motor, pump and filter mounted on a laminated plastic panel and weighs only 30 pounds. The 110-volt motor operates on either AC or DC. For further information, use Reader Service Card.

E—132. Balance with Stainless Steel Components—The Ohaus Scale Corporation, 10–14 Hobson Street, Newark 8, N. J., announces a new Triple Beam Balance featuring a stainless steel platform and beams, now available through scientific supply dealers from coast to coast.

Heat, chemicals or accidental sharp blows are said not to affect the platform or the relief-etched beams that give clear, accurate readings. According to the manufacturer, self-aligning bearings of high-grade polished agate insure minimum friction and full contact along the knife edges at all times. The sliding-type poise insures stability and freedom from swinging when scale oscillates, thus maintaining sensitivity. The steel tongue fits

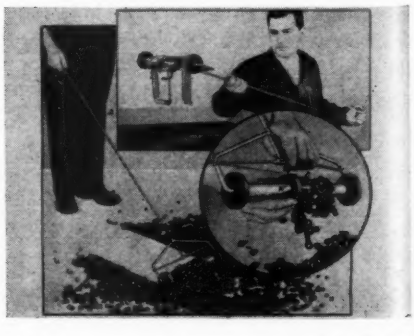


into accurately milled notches at every calibration and insures correct positioning. For further information use Reader Service Card.

E—133. Rotary Magnets for Tank, Floor and General Uses—New loading and releasing principles feature a complete new line of non-electric Multilift Rotary Magnets manufactured by Multifinish Manufacturing Company, Dept. 484, 2114 Monroe Avenue, Detroit 7, Mich.

The manufacturer states that these units will retain their strength forever without charging, requiring no wires or electricity. Alnico permanent magnets are sealed in a metal tube mounted rigidly between Neoprene wheels in the carrying frame. Handle is attached to frame and unit is rolled; the tube revolves with the wheels and the entire magnetic surface becomes loaded, thus providing capacity greater than when only underside of magnet can be loaded. Unloading is accomplished by pushing Neoprene wiper ring to a non-magnetic area at one end, where the load drops off. "Grabbing" tanks is prevented by the wheels; and parts jump 1 or 2 inches to the tube.

Multilifts are available immediately in



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PATENTED
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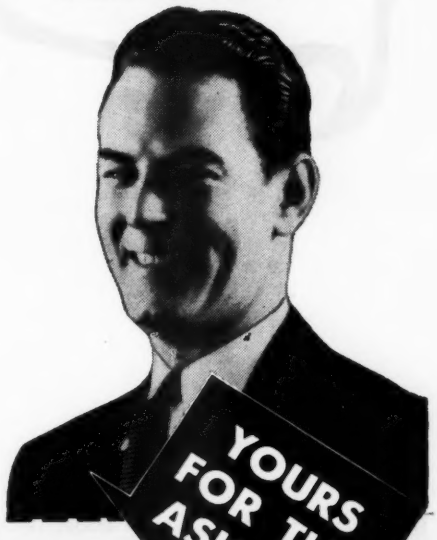
LEADING PLANTS REPORT:

GRIPMASTER BOOSTS POLISHERS' PRODUCTION AN AVERAGE OF 47% MORE PIECES PER HEAD!



Now! **Longer Wheel Head Life!** Thanks to Gripmaster's special high-heat resisting ingredient!

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Now! **Inventories Simplified!** One grade grips *all* grains—300 to 20. No special sizer needed!

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P-9

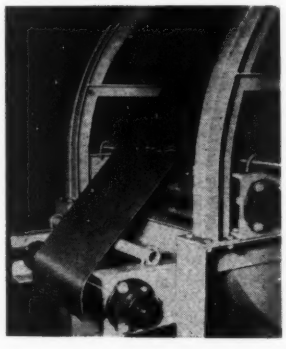
sizes and materials suited to intended uses; for tanks the exposed metal is non-magnetic stainless steel. Standard wheel diameter is 2⅝ inches; length of smallest model is 9½ inches, larger units being 13¾, 18 and 22¼ inches. For further information use Reader Service Card.

E—134. Plating Barrel—Completely self-contained plating barrels with individual low voltage rectifiers are a recent development of the Daniels Plating Barrel and Supply Company, 129 Oliver Street, Newark 5, N. J.

For highest efficiency, this Daniels Plating Barrel Unit is incorporated with a specially constructed convection-cooled selenium rectifier complete with controls and meters. The unit is said to be adequately designed for protection against solution corrosion, and 25 per cent continuous overload tests insure long life of this unit. The rectifier and controls are mounted in accessible position for easy readings and operation.

These units can be furnished for any plating solution except chromium. The spacious cylinder of Daniels Plating Barrels, which is mounted at an oblique angle, allows maximum load capacities and rapid loading and unloading. This, and unique contact design, is claimed to afford maximum plating efficiency. For further information, use Reader Service Card.

E—135. Continuous Filter for Precipitated Waste Pickle Liquors—Announcing a new, small, continuous FEinc vacuum filter as the easiest way to abide by state pollution laws and get rid of the



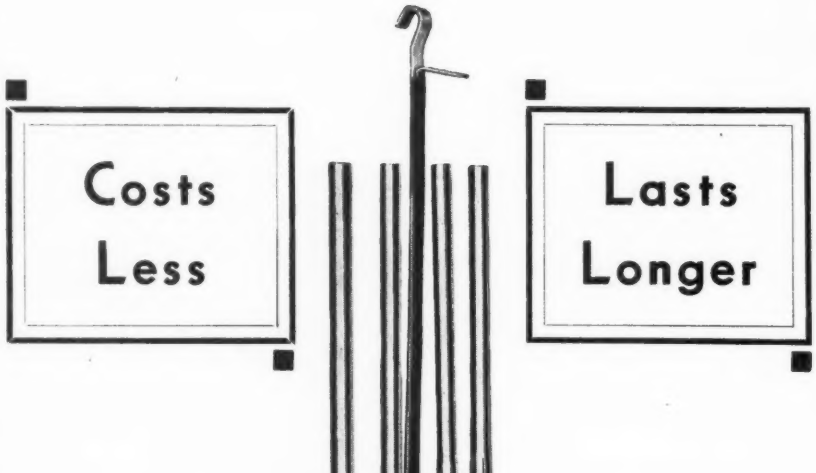
nuisance of waste pickle liquor, Filtration Engineers, Inc., culminates several months of joint research with steel mills, neutralization process manufacturers, and others.

Used in conjunction with any waste acid neutralizing process which results in a suspension of iron oxides and other solids in a neutralized solution, the FEinc continuous filter separates this suspension into clear filtrate which can be released into streams without danger of acid pollution and easily handled solid cake. The new filter is a special adaptation of the FEinc String Discharge filter that has long given service with commercial iron oxides and pigments. It is said to be simple and sturdy and to have low overall operating cost.

Filtering rate of this small model ranges from 60 to 600 pounds of dry solids per hour, depending on nature of waste liquor and type of neutralizer used. It works equally well on pickle liquor that has been diluted before neutralization and on waste acids that have been used to neutralize waste alkalies before being completely neutralized by the lime or other process. The cake, containing 55 to 75 per cent moisture, can be handled easily by conveyor or truck. For further information, use Reader Service Card.

E—136. High Capacity Rectifier—Engineered and built to fill the need for a direct current power source for requirements up to 5,000 amperes with varying voltages from 1 to 9 volts, the Style 5009 rectifier manufactured by Bart-Messing Corporation, 45 Morgan Avenue, Brooklyn 6, N. Y., is said to be particularly well suited for chromium, bright nickel

Single Dip



BUNATOL No. 1000 Paste insulation saves time and labor because it requires only a single dip coat and a short oven bake. The resulting rack insulation is extremely tough and resistant to all plating solutions and cleaners. Racks will operate for months without breakdown, and without drag out or carry over. First cost is less and final cost-per-hour very low. There are no rack insulation problems when you use BUNATOL No. 1000 Paste. Write for complete information.

NELSON J. QUINN CO.—TOLEDO 7, OHIO

BUNATOL

and acid copper plating as well as for electro-cleaning and electropolishing.

The unit has a full load efficiency of 72 per cent, increasing to 83 per cent at 20 per cent load, and features a continuous

plating control which permits changing tap switch positions without plating interruption. The selenium stacks are conservatively rated with 15,500 square inches of rectifying area and are heavily coated for corrosion protection. The safety elements include positive overload protection in DC bus circuit; positive protection against ventilation restriction because rectifier will automatically shut off if air intake is blocked; cabinet internally lined with Tygon for protection against corrosion.

The cabinet is mounted on ball bearing casters for mobility and provided with doors for quick accessibility for maintenance. For further information, use Reader Service Card

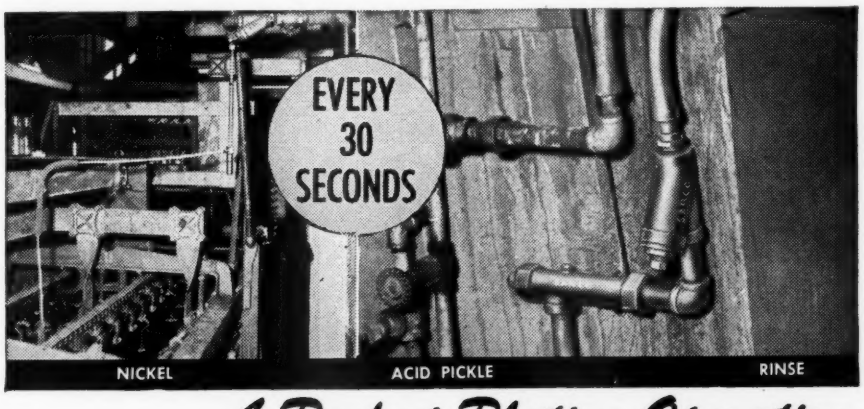
E—137. New Germicide for Equipment Sanitation—A newcomer to the field of personal protective items is an especially powerful germicide announced by Willson Products, Inc., Reading, Pa. It is said to be a non-corrosive, non-staining solution, which is practically odorless. Though about twenty-five times more powerful than carbolic acid, the germicide is claimed to be non-poisonous and non-irritating to the skin. In addition to its powerful germ-killing action, the solution acts as a deodorant and fungicide.

Effective in hot or cold water, it may be used as a spray, swabbing solution, or immersion solution for gas masks, goggles, respirators, safety shoes, boots or any washable apparel.

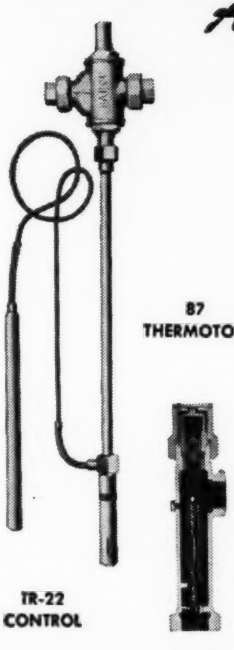
E—138. Touch-Up Pencil—Rustproofing of metal, regalvanizing, and tinning of bearings can be done quickly and easily with the new "Kromover" touch-up pencil, according to All-State Welding Alloys Company, 96 W. Post Road, White Plains, N. Y. It is said to tin oil-impregnated bronzes, burned cast iron, all stainless steels, and black iron without removal of mill scale as long as oil and dirt has been wiped off with a clean rag. The protective coating formed by the pencil is corrosion-resistant and, unlike tinplating, sacrifices itself to protect the iron and steel on which it is applied. It goes on at 450° F and can be applied with oxy-acetylene, air-acetylene, or city gas flame. For further information use Reader Service Card.

E—139. Counting-Weighing Scales—Newly designed scales manufactured by National Scale Company, 43 Mills Street, Springfield, Mass., enable one man to handle bulky or heavy material by merely rolling the scales over the boxes, barrels, drums or other item to be weighed or counted. They also eliminate time-consuming handling of goods to central scale installations. The new scales are mounted on wheels and four-foot high legs and are rolled over the objects, and standard grabs fastened on. A hydraulic-lift swings the load clear of the floor or skids, and direct weight or count readings are taken from the indicating head in the standard way. The scales are also used in taking of inventory as they can be rolled down over a line of stored materials without moving the materials with hand or lift trucks. Models now in production have a weighing capacity of 1,000 pounds or a counting ratio of 200 to 1, and the counting scales will accurately count pieces weighing one ounce or more. For further information, use Reader Service Card.

E—140. Low-Headroom Hoist Installation—An unusual and ingenious application of a standard low-headroom lug-type electric hoist manufactured by The Yale and Towne Manufacturing Company, Materials Handling Division, Philadelphia, Pa., has provided one manufacturer with a neat solution to the difficult problem of handling large numbers



A Perfect Plating Operation



Automatic plating units never wait. When they hit the tanks, the temperature must be right and in less than a minute the job must be done—right. In the busy plating plant illustrated, every step is temperature controlled—sometimes with the inexpensive Sarco No. 87 Trap-Control—at others with the more exacting TR-22 control.

The result is mass production with a high accuracy that is repeated, day in and day out. Reduction in the number of rejects paid for these controls in a few months. And the strange thing is that less heat is wasted when perfect plating is secured with Sarco Controls.

Eventually you will find your plant in competition with temperature controlled plating. Why not look into the question now and save the original cost of the controls over and over for years to come? The Sarco Representative near you will be glad to show you how. Ask for Sarco Catalog No. 650 on plating and finishing controls.

186

SARCO SAVES STEAM

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Represented in Principal Cities
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SARCO CANADA LTD. TORONTO 5, ONTARIO

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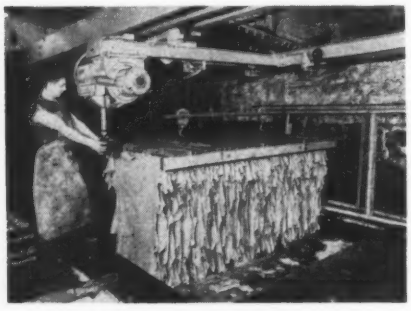
of hides in the particularly close quarters of his leather processing department. Although this application deals specifically with immersing leather in bating and tanning solutions, similar applications can be extended to electroplating, cleaning, coating, dyeing, nd similar immersion



operations. Other types of low-headroom handling problems can be solved by analogous hoist applications.

A short stiff arm with control buttons located at its extremity permits one operator easily and safely to perform the loading, hoisting, pushing and dipping operations in a series of tanks with a minimum of physical exertion. For further information, use Reader Service Card.

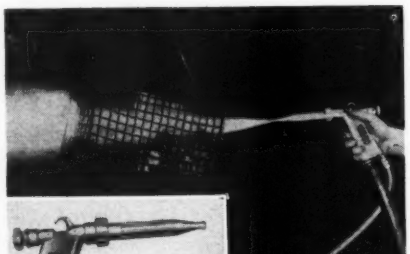
E—141. Water Demineralizer—A low cost unit consisting of a replaceable cartridge containing cation and anion synthetic exchange resins, a wall-type cartridge holder, and an electronic indicator for quality of treated water is now offered by A. E. Tomkin & Company, P. O. Box 7311, Washington, 4, D. C. One cartridge of this Hydrion unit is said to have the capacity to remove more than 500 grains of hardness, i. e., will demineralize about 200 gallons of New York City water, about 75 gallons of Washington, D. C., water, about 50 gallons of Chicago water, etc. Upon exhaustion the cartridge is simply removed and replaced. For further information, use Reader Service Card.

E—142. Selenium Rectifiers for Solution Purification — Special "Solution Cleaning Units" are now being offered by

Richardson-Allen Corporation, 15 W. 20th Street, New York 11, N. Y. They may be used either for continuous purification in a separate tank through which the solution is being pumped or for periodic purification during nights and off-hours in the main plating tank. The smallest unit of 50 amp/1 volt is only 15 x 9 x 17 inches high and weighs 75 pounds. Other models offered have capacities of 100 amp and 200 amp, both at 1 volt. Stepless voltage control from 0 to 1 volt and convection cooling are featured. For further information, use Reader Service Card.

E—143. Chemically Inert Packings—An improvement in packings for valves, centrifugal and rotary shafts, reciprocating rods and other points is now available in the "Chemlon" line of Crane Packing Company, 1800 Cuyler Avenue, Chicago 13, Ill. Teflon, the basic element of the line, is du Pont's chemically resistant flexible plastic, unique for its inertness. It is said not to be affected by any solvent acid mixtures or by acids or caustic solutions at temperatures as high as 690° F and to provide a most efficient seal against the escape of liquids, fumes or gases of a highly inflammable or corrosive nature. Excessive wear of reciprocating rods, shafts and valve stems is claimed to be eliminated by the non-adhesive characteristics. The line is available in several types to meet different requirements as to form and service. For further information, use Reader Service Card.

E—144. Pressure Washer—An improved pressure washer, the Hydro-Air,



with a broad range of applications to industrial cleaning jobs, has been announced by D. & M. Products, Inc., 4655 Kingswell Avenue, Los Angeles 27, Calif.

Using a precisely controlled mixture of water and compressed air, the Hydro-Air produces a blast of "cold steam" that is said to penetrate and clean without back splash or harm to finish. Its effectiveness has been proved in the automotive field in such difficult applications as the cleaning of motors, chassis, transmissions and other parts.

The Hydro-Air pressure washer is claimed to effect a saving of time and labor in metal processing, maintenance and repair, and degreasing or paint stripping departments. Through the use of varying adjustments, the washer can remove heavy dirt and grease or quickly and thoroughly rinse cleaning solvent from sheets and parts. For further information, use Reader Service Card.

E—145. Unbreakable Acid Pail—A line of acid handling utensils, which includes a 3 and 5-gallon pail, measure in 2-, 4- and 6-quart capacities, a 2-quart dipper and 10-inch funnel is now offered by Automotive Rubber Company, Inc., 8600 Epworth Boulevard, Detroit 4, Mich. These utensils are made of perforated steel with welded seams and covered, inside and out, with rubber, permanently welded through and closing the perforations. Pails are shaped to decrease likelihood of fluids splashing or spilling when carried. Bails or handles are completely rubber covered. A pouring dip is formed on the edge and a tipping handle is provided at the base to make for easier and safer pouring. For further information, use Reader Service Card.

E—146. Paint Stripper—The London Chemical Company of 607 S. Dearborn Street, Chicago. Ill., announces the development of a nonionic, non-flammable cold-dip paint stripper that is water soluble and fast acting. This new product, identified as Kwickstrip, does not give off obnoxious fumes and is claimed to maintain efficiency for unusually long periods.

Any organic finish is said to be easily removed from a metallic surface including aluminum, zinc, magnesium, or cadmium and also from wood surfaces as it is non-grain raising. For further information, use Reader Service Card.

E—147. Chemical-Resisting Tape—A synthetic resinous tape, which resists chemical attack and aging and insulates electrically, has been announced by United Chromium, Incorporated, 51 E. 42nd Street, New York 17, N. Y. Known as Unichrome Tape 705, this product is designed especially for use by the electroplating industry as a coating for racks or for stop-off purposes. However, it is said that its properties will find it a wide application in other fields where chemical resistance or a flexible, easily handled insulator is required.

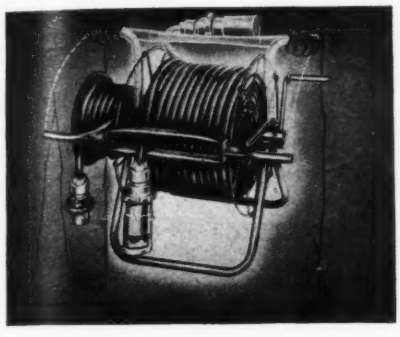
Unichrome Tape is said to resist the severest plating and anodizing baths, hot cleaners, pickling solutions, and electrocleaners. Tests have revealed no deteriorating effects on the tape by cyanide copper bath or alkaline cleaner. It is reported that tape tested 48 hours in chromic acid had a negligible weight loss, which is claimed to be proof of outstanding chemical resistance.

Unichrome Tape is green in color, with a smooth, "slick" surface. Its elasticity permits snug taping without pockets. Wrappings are anchored by cementing down only the ends of the tape. Cementing may be dispensed with if desired, and

Equipment and Supplies

the tape fused into one continuous coating by baking at 275° to 300° F for 15 to 30 minutes. For further information, use Reader Service Card.

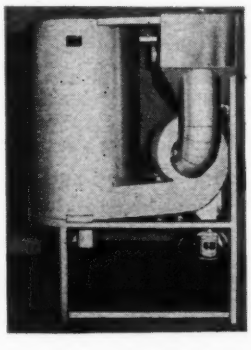
E—148. **Power—at a Distance**—Problems of transporting heavy electrical cables are said to find a ready solution with the latest development of the Industrial Electrical Works, 1509 Chicago Street, Omaha, Neb., Dept. 160. Called the Powereel, the new device is a portable reel designed to house up to 300 feet of ¾



inch No. 12 four-conductor cable or equivalent. Designed for use with any phase current, the reel comes standard with 3 or 4 collector rings. The rings are of heavy beryllium copper with double copper contact brushes, and are seated in a phenolic casting, housed in metal. The Powereel is rated 75 amps at 220 volts.

Sold without cable and plugs, the reel weighs 21 pounds for the standard models. Manufacturer will supply any available cables and plugs to order at existing prices. Special reels and collector rings for more than 4 conductors may be had upon request. For further information, use Reader Service Card.

E—149. **Self-contained Dust Separator**—Industrial Electroplating Company, Inc., Indianapolis, has begun manufacture of a second unit in its line of industrial



air cleaning equipment which incorporates principles of water action and centrifugal separation.

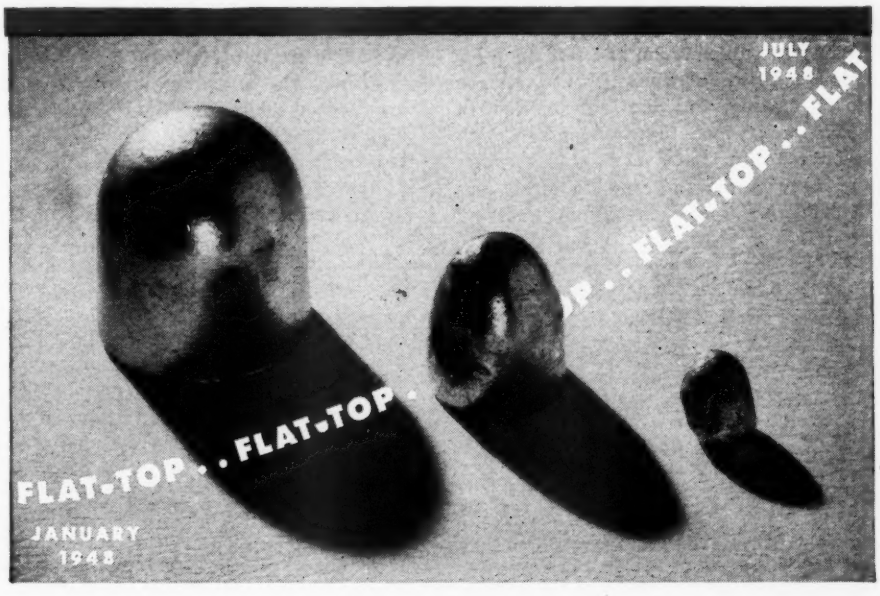
The newest unit, the Niehaus Dust Separator, employs wet methods to remove from the air the dust and foreign particles that result from polishing, buffing and grinding operations. The unit thoroughly mixes finely divided particles of water with dust-laden air and, by centrifugal action, washes out the entrained foreign material.

The clean air is discharged out of the top of the machine into the shop, eliminating heat loss common to machines that discharge out-of-doors. The unit contains its own blower and water recirculating systems. Refuse is collected in a portable tank beneath the unit, making disposal or reclamation easy.

The Niehaus Dust Separator contains no filters or bags to clog up or be replaced, and the wet methods employed eliminate fire hazards. It is designed to provide a two-inch static pressure for exhausting four regular size buffing or polishing wheels up to 16 inches diameter. Where conditions require, the unit supplies four-inch negative pressure for three wheels, and a maximum of six inches pressure is available for exhausting two wheels.

The unit is delivered complete with motor, pump and motor controls, and is designed to be placed alongside the machines being exhausted. For further information, use Reader Service Card.

E—150. **Safety Floor Finish**—Substantial progress in the elimination of one of the most common industrial accidents—slips and falls resulting from hazardous footing—is said to be accomplished by the increasing use of a new safety floor finish, Traffic-Tred, a product of the Industrial Safety Products Division of The Watson-Standard Company, 225 Galveston Avenue, Pittsburgh 30, Pa. This abrasive floor coating is applied like paint and dries to a hard, rough surface with a texture much like coarse sandpaper. It is



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There's a solid reason for a five-fold increase in Wagner zinc shipments since January, 1948. It's that distinctive Flat-Top shape which avoids mixing with cadmium or tin anodes. And Flat-Top retains its recognizable form right through the process. A glance at the basket tells the tale, prevents incorrect reloading, eliminates dumping, saves you labor and material.

Flat-Top is smooth, reducing hanging on basket wires. Made from highest purity zinc obtainable, 99.99+%. Sealed in wooden kegs. Sold by qualified metal-finishing supply houses in principal industrial areas.

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Equipment and Supplies

said to work equally well on steel, wood or concrete, removing most of the danger from walking areas subject to dampness, greasiness and other slippery conditions. For further information, use Reader Service Card.

E—151. Color Buffing Compositions — The Hanson-Van Winkle-Munning Company, Matawan, N. J., has perfected a new bar composition for color buffing carbon steel, stainless steel and chromium plate, designated as 6-B-72.

In order to produce a good color on the above-mentioned metals, free from cloud or cast, it is necessary that the compound produce a very light and soft face on the buff with sufficient lubrication to prevent scratching. Compositions producing this type of buff face have very limited cutting ability.

6-B-72 Composition has a binder that retains the abrasive on the buff face for a longer period of time, permitting it to do its cutting, and does not build up a heavy waxy face that prevents a high color free from casts. It produces a high finish on carbon and stainless steels and at the same time cuts out imperfections left from the cutting down operations. It also will rapidly cut and color burned chromium plate. For further information, use Reader Service Card.

E—152. Moisture-Proof Wiring—A new electrical wire with rubber insulation that improves when soaked in water has been developed by United States Rubber Company, Rockefeller Center, New York City, for use underground and in wet locations where high moisture resistance gives it longer life and increased safety. It is particularly suitable for underground lead-ins and wiring damp basements. Secret of the wire's durability is a coating of high purity natural rubber latex applied by the dip process.

Tests conducted by Underwriters' Laboratories, Inc., where the wire was immersed in water at a temperature of 122° F for twenty-four weeks, showed an insulation resistance curve that rose from 500 megohms to 2,400 megohms per 1,000 feet of wire. A normal insulation resistance curve shows a sharp drop after two to four weeks' immersion.

In addition to greater moisture resistance, the insulation of the new wire has improved tensile strength and elongation. It is being marketed under the trade name "Laytex RUW". For further information, use Reader Service Card.

THE USE OF PLASTIC BEADS IN CHROMIUM PLATING TANKS

Among the references cited in the above-titled article which appeared in the June issue should have been included the following: C. T. Thomas, "The Conservation of Chromic Acid in Chromium Plating". Mo. Rev. Am. Electroplaters' Soc. **30**, 720–724 (1943). Mr. Thomas reported that floating beads to prevent spray had been used some 40-odd years earlier in the electrolytic manufacture of sodium chlorate and that the Bureau of Engraving and Printing had used polystyrene rods in chromium plating tanks very successfully for over a year.

A. E. S. EMBLEMS

Membership pins and buttons, Branch Past-President's buttons, and A.E.S. Past-President's buttons are now available.

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Get yours now, through your Branch Secretary or direct from American Electroplaters' Society, P. O. Box 168, Jenkintown, Pa.

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Write for illustrated brochure.

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New Literature

L—99. **Plating Equipment** — The Meaker Company, 1629–41 S. 55th Avenue, Chicago 50, Ill., has just issued a 36-page booklet, No. 148, entitled "Plating and Processing Equipment". This booklet describes the Meaker designs of automatic, semi-automatic, and special machines for plating and other sequence processing. Included are many illustrations showing the different type machines under diversified operating conditions. A section of the booklet is devoted to plating data tables. For your copy, use Reader Service Card.

L—100. **Insulation Tape**—Minnesota Mining & Manufacturing Company, 900 Fauquier Avenue, St. Paul 6, Minn., offers a two-page Scotch Electroplating Tape Data Sheet containing a comprehensive list of physical and chemical properties and a recommended procedure for application to plating racks. For your copy, use Reader Service Card.

L—101. **Electronic Proportioning Pyrometer Controller**—A new bulletin, No. PB1237, describing a proportional current-input electronic pyrometer controller has just been published by The Bristol Company, Waterbury 91, Conn. It describes the application of the new instrument in proportioning the current input to electrically heated furnaces, ovens, plastic molding machines, salt pots, and other similar equipment to provide practically straight line control. For your copy, use Reader Service Card.

L—102. **Corrosion Resisting Alloys**—A new Bulletin 114 on nickel-molybdenum and nickel-molybdenum-chromium alloys, introduced about two years ago by The Duriron Company, Inc., Dayton 1, Ohio, has just been issued. It includes much information on Chlorimet 2 and Chlorimet 3, not previously available. Particular attention is given to their use for sulfuric acid, hydrochloric acid and salt solutions. In all, 120 corrosives are dealt with.

Chlorimet 2 and Chlorimet 3 are available in cast form. Durco-pumps and valves are now regularly supplied in in these alloys. For your copy, use Reader Service Card.

L—103. **Selenium Rectifiers**—An 8-page catalog in color describing, illustrating, and giving engineering data on a complete line of selenium rectifiers for electroplaters, electrotypers, anodizers and all other indust ial users of AC to DC power conversion equipment is announced by Richardson-Allen Corporation, 15 W. 20th Street, New York, N. Y.

Units cover range from 6 volts to 28 volts with maximum of 4000 amperes in a sing'e cabinet, and include basic models, remote controls, self-contained units and many special purpose units Tables show ratings of the wide range of models available, and a wiring diagram illustrates graphically necessary hook-up information. For your copy, use Reader Service Card.

L—104. **Index to 1947 A. S. T. M. Standards**—This publication, issued in May, 1948, is an adjunct to the 1946 Book of Standards (6,600 pages) and the 1947 Supplements (1,800 pages), and enables any of the some 1,500 standard specifications and tests in the volumes to be located readily. The Index is also of service to those who wish to determine whether A. S. T. M. has issued standard specifications, test methods, or definitions covering a particular engineering material or subject.

All items are listed in the Index under appropriate key-words according to the particular subjects they cover. As a convenience a list is given of the specifications and tests in numeric sequence of their serial designations. Copies of the 240-page publication are furnished without charge on written request to A. S. T. M. Headquarters, 1916 Race Street, Philadelphia 3, Pa.

L—105. **Conservation of Chromic Acid**—The Udylite Corporation, Detroit 11, Mich., offers a 2-page illustrated bulletin describing its "Chrome-Lock Tubes" for blanketing surfaces of chromic acid tanks. A table shows results of controlled tests with varying blanket thickness. For your copy, use Reader Service Card.

L—106. **Plating Equipment**—A 4-page bulletin illustrates and lists a variety of cleaning equipment and tanks manufactured and distributed by Randall Manufacturing Company, 410 E. 93rd Street, New York 28, N. Y. The equipment is used in the treatment of large or small parts in the plating and finishing industries. For your copy, use Reader Service Card.

L—107. **Plating Rack Components**—The Standard Plating Rack Company, 1913–1925 N. Paulina Street, Chicago 22, Ill., has issued a 12-page bulletin covering plating rack parts, accessories, tools, materials, tips, insulation, and repair equipment. The bulletin describes the uses of the various parts and components. The technique of rack manufacture is set forth in a clear and concise manner. Every item necessary to make a rack is listed. For your copy, use Reader Service Card.

L—108. **Salt Spray Testing Machines**—A new Bulletin 709, issued by Belke Manufacturing Company, 947 N. Cicero Avenue, Chicago 51, Ill., describes in detail the Belke Salt Spray Machines for salt and other spray tests of bare metal and protective coatings such as anodized or electroplated coatings, paints, rust preventatives, etc.

The machines are said to conform with Government Specifications for Salt Spray Testing Equipment in Federal Standard Stock Catalog QQ-M-151a (March, 1945).

L—109. **Temper Designations for Aluminum Alloy Mill Products**—An article with the above-mentioned title is featured in Issue No. 8 of Vol. 1 of the Technical Advisor, house organ of Reynolds Metals Company, Louisville, Ky. It describes the various tempers, gives the modified system of designation recently adopted by major producers and shows tables for conversion from former to present designations. For your copy, use Reader Service Card.

L—110. **Nickel Plating**—"Practical Nickel Plating" is the title of a 48-page, magazine-size manual written by Dr. W. A. Wesley and W. H. Prime and issued by The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y. Its scope is indicated by the chapter headings: Applications; Plating Solutions; Conditions and Properties of Deposits; Preparation of Basis Metals; Special Precautions for Heavy Work (deposits); Plating Difficulties and Their Correction; Purification of Solutions; Effect of Elevated Temperatures on Nickel Deposits; Stop-offs; Machining and Grinding Nickel Deposits; Stripping Nickel and Chromium Deposits; Nickel Anodes; Materials of Construction (of plating equipment); Bibliography. The booklet ends with a detailed index and a list of reprints of articles available from the Company. For your copy, use Reader Service Card.

L—111. **Chemical-Protective Coatings**—A new 4-page folder showing how to cut costs in areas where corrosion is a problem is now ready for release by Prufcoat Laboratories, Inc., 63 Main Street, Cambridge, Mass. Included are many actual case histories from leading plants in many different types of industries which are now using Prufcoat coatings. In pictures and statements these users tell how the coatings cut painting maintenance costs by providing machinery, equipment, walls, floors, etc., with effective protection against corrosion by acids, alkalies, oil, and water. For your copy, use Reader Service Card.

New Literature

L—112. Chemical-Resistant Coatings—The Wilbur & Williams Company, Greenleaf and Leon Streets, Boston 15, Mass., has recently issued three technical bulletins on vinyl plastic coating materials, which, while not a paint, can be brushed, sprayed, or dipped like paint.

Acid-Causticbond Maintenance Coating is a general maintenance plastic coating that is used where corrosion is being caused by fumes of acids or alkalis or the occasional spillage of acids or alkalis. It is said to make an ideal coating for the outside of plating tanks, overhead structures, and also for concrete floors.

Acid-Causticbond Tank Lining is used where corrosion is being caused by concentrated fumes of acids or alkalis or continual spillage of acids or alkalis, or for lining tanks containing strong acids or alkalis. It is composed of a prime coat, intermediate coats, and body coats. When thoroughly dry, the surface is said to be tough, hard and glossy. For your copy, use Reader Service Card.

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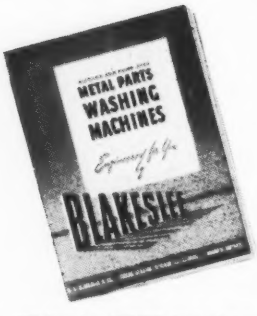
METAL PARTS WASHER



To assure 100% grease free surfaces for subsequent finishes to automobile bodies, refrigerators, washing machines, toys and hundreds of other products, choose a Blakeslee Metal Parts Washer, especially adaptable to the cleaning of metal parts prior to surface treatment. Blakeslee sprays are designed to reach all surfaces and each machine is "tailor made" to do a specific cleaning job. From our experience in handling every metal piece from small watch parts to diesel engine crankcases, we have been able to build a washing machine designed to do a perfect job and to last for years.

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NEW YORK, N. Y. TORONTO, ONT.

L—113. Odor Control—The benefits to be gained with the use of specialized cleaning, disinfecting and deodorizing materials in connection with industrial-housekeeping plant-sanitation programs, are described in an illustrated 12-page booklet just released by Oakite Products, Inc., 140 Thames Street, New York 6, N. Y.

It reports on two specific materials, each of which possesses the ability to perform diverse activities with a single application. The first, double-action Oakite Di-Sanite, is said to combine thorough, all-purpose cleaning action with effective deodorizing ability. The second, Oakite Tri-Sanite, has germicidal and fungistatic properties in addition to its odor-killing and light detergent characteristics.

Low concentration solutions of these materials, applied directly to surfaces by spraying, swabbing, brushing, soaking or steam gun, are claimed sufficient to supply "at-the-source" deodorization and efficient detergent action. Many diversified applications in various types of industrial plants, working directions, recommended concentrations, etc., are given. For your copy, use Reader Service Card.

L—114. Combustion Safeguard for Gas Burners—Combustion Control Corporation, 77 Broadway, Cambridge 42, Mass., has introduced Fireye System FF-6, which is described in its Bulletin CG-4751. This system provides electronic flame-failure protection and semi-automatic ignition control for all types of commercial and industrial gas burning equipment as well as for oil fired equipment having continuous gas pilot ignition. It is recommended for use on boilers, ovens, furnaces, kilns and dryers.

Fireye Systen FF-6 includes an Electronic Flame Rod, Type 45JQ1, and Control, Type 24QJ5. The Flame Rod is mounted near the gas pilot on the burner plate and projects into the fire chamber. The rod is so located that its tip impinges on the pilot or main gas flame. The rod is wired to the control which may be located at any convenient point such as on the burner panel board. For further information, use Reader Service Card.

L—115. Buffing and Polishing Machine—The 8-spindle automatically indexing Vanott buffing and polishing machine is presented in a 4-page illustrated bulletin offered by Vanott Machine Corporation, 248 Colgate Avenue, Buffalo 20, N. Y. For your copy, use Reader Service Card.

L—116. Water Conditioning Equipment—A 12-page publication No. 4425 issued by Cochrane Corporation, 17th Street and Allegheny Avenue, Philadel-

New Literature

phia 32, Pa., describes a cold-process softener which combines the basic equipment for mixing, floc formation, settling, and thickening in a single reaction vessel, the Cochrane "Rapid Reactor". Details of the process and of operation of the equipment are discussed, and three general designs and two typical installations are described and illustrated. For your copy, use Reader Service Card.

L—117. **Galvanic Corrosion**—A new 10-page booklet, offered by International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y., is designed for production men as well as research engineers and discusses various aspects of galvanic corrosion. The booklet not only covers some of the factors influencing galvanic corrosion but also presents data on how galvanic effects can be minimized. For your copy, use Reader Service Card.

L—118. **Dust Collector System**—A 4-page bulletin on the Mikro-Collector, manufactured by Pulverizing Machinery Company, 180 Chatham Road, Summit, N. J., covers details of this method of dust collecting, one feature of which is said to be the ability of the equipment to handle damp and hitherto baffling dust loads. For your copy, use Reader Service Card.

L—119. **Air Filters**—A complete line of dry-type intake-air filters for all types of air compressors, diesel and gas engines, blowers, motors and generators is covered in a new 8-page Bulletin SIF describing the products of Dollinger Corporation, Rochester 3, N. Y. They include silencer models, regular dry-type and breather filters, ranging in size from 6 cfm to 8000 cfm. All filters feature the concern's radial-finned insert design. For your copy, use Reader Service Card.

L—120. **Condensate Units**—A new 10-page Bulletin No. 201 manufactured by Roy E. Roth Company, Rock Island, Ill., covers the type U "packaged" condensate-return units. It gives general catalog data, descriptions, complete specifications and prices on the units, parts and accessories. For your copy, use Reader Service Card.

Copies of January and March Issues Desired

The Executive Office has only a few copies left of the January, and March 1948 issues of PLATING.

If those who do not plan to keep their copies would send them to P. O. Box 168, Jenkintown, Pa., their assistance will be very much appreciated.

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2—5000/2500 Ampere, B. & O'C. with Chandeysson synch. motor, 450 RPM
1—5000/2500 Ampere, Columbia, 690 RPM
1—2000/1000 Ampere, H-V-W, 690 RPM
1—1250/625 Ampere, H-V-W, 850 RPM
1—1000/500 Ampere, Chandeysson, 690 RPM
1—1000/500 Ampere, Columbia, 1150 RPM
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Single Commutator

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1—1000 Ampere, 15 V. Gen. Elec.
1—300 Ampere, 15 V Star
1—800 Ampere, 22/33 V Gen. Elec.
3—1500 Ampere, 20 V. Elec. Prods.
1—67 Ampere, 24 V. West.
1—600 Ampere, 24 V. Reliance
1—200 Ampere, 25 V. Star
1—1000 Ampere, 25/35 V. Diehl
1—300 Ampere, 25 V. Star
1—175 Ampere, 25 V. Cr. Wh.
1—500 Ampere, 32 V. Columbia
2—100 Ampere, 30 V. Gen. Elec.
1—200 Ampere, 30 V. West.
2—200 Ampere, 32 V. Gen. Elec.
2—1500 Ampere, 32/40 V. Elec. Prods.
1—1000 Ampere, 33 V. Gen. Elec.
2—200 Ampere, 42 V. Gen. Elec.
3—1500 Ampere, 45 V. Century
1—1500 Ampere, 50 V. Gen. Elec.
2—800 Ampere, 50 V. Gen. Elec.
1—400 Ampere, 50 V. Gen. Elec.
6—1500 Ampere, 50 V. Elec. Prods.
1—1000 Ampere, 60 V. Gen. Elec.

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A. E. S. News

Golf Tournament Winners

Mr. J. J. Duffy, Jr., Pennsylvania Salt Manufacturing Co., reports the following winners of the golf tournament held during the recent A. E. S. Convention in Atlantic City and sponsored by the International Fellowship Club:

First Prize (golf sweater)—Mr. C. A. Escoffery, Federal Telephone & Radio Corp., Harrison, N. J.
Second Prize (golf sport shirt)—Mr. R. W. Renton, R. W. Renton Co., Cleveland, Ohio
Third Prize (golf balls)—Mr. L. Pivarcy, Murray-Ohio Corp., Cleveland, Ohio
Fourth Prize (golf raincoat)—Mr. J. Joyce, Sperry Gyroscope Company, Brooklyn, N. Y.
Fifth Prize (golf jacket)—Mr. C. Schaefer, Casco Products Corp., Bridgeport, Conn.
Sixth Prize (golf umbrella)—Mrs. McNeilly, Bacon Felt Co., Winchester, Mass.

Available Branch Speakers, 1948-1949

The following names are added to the list published in the July issue:

ELECTRIC PRODUCTS COMPANY (c)
1725 Clarkstone Road, Cleveland 12, Ohio
GORDON J. BERRY, Areas not specified below

GERALD J. DOSS, East and South Central
126 Liberty Street, New York 6, N. Y.

R. J. PECK, East and Middle Atlantic
618 Fisher Building, Detroit 2, Mich.

E. G. SCHROEDER, North Central
915 Old Colony Bldg., 407 S. Dearborn Street, Chicago, Ill.

R. R. KOVACH, Mid Central and West Central
Subjects:
Power for the Plating Plant
The Modern Plating Motor Generator Set
Motor Generator Sets and Rectifiers for Electroplating

KOLD-HOLD MANUFACTURING COMPANY (c)
Lansing 4, Mich.
CARL BLOOMQUIST, Research Engineer, North Central
Subject:
Heat Transfer in Plating Tanks

NATIONAL CARBON CO., INC. (c)
30 East 42nd St., New York 17, N. Y.
292 Madison Ave., New York, N. Y.
J. REYS, Division Engineer, East

Rm. 1715, Clark Bldg., Pittsburgh, Pa.
H. B. ALPORT, Division Engineer, North Central

230 N. Michigan Ave., Chicago, Ill.
J. F. BRAUNING, Division Engineer, Midwest

Subject:
Carbon, Graphite and "Karbate" Products in Anti-Corrosion Equipment

Branch Membership Prizes

The beautiful cups shown here were presented at the Annual Banquet of the

(*Continued on page 966*)

Theodore H. Webersinn

Theodore H. Webersinn, Chief Chemist at The Autoyre Company, Oakville, Connecticut, died on July 15 at the age of forty-one. His death was due to the accidental inhalation of an excessive amount of fumes from a nitric-sulfuric acid bright dip for brass.

Mr. Webersinn was born at Flushing, New York, January 23, 1907. He attended Columbia University for six years, receiving the degrees of Bachelor of Arts in 1927, Bachelor of Science in 1928, and Bachelor of Chemical Engineering in 1929. While at Columbia he was elected to Sigma Xi and Phi Lambda Upsilon. He was employed as a research engineer by United Chromium, Incorporated from 1929 to 1944, becoming manager of the Waterbury Laboratories of United Chromium, Incorporated in 1940. He was also active in the establishment of the Company's Organic Coatings Division. From December of 1944, Mr. Webersinn was Chief Chemist at The Autoyre Company.

In addition to being a very active and congenial member of the Waterbury Branch of the American Electroplaters' Society, Mr. Webersinn was a member of the Electrochemical Society, the American Chemical Society, the American Society for Metals, and the Electrodepositors' Technical Society. He was the source of many important contributions to the chromium plating art, and to plating in general.

Branch News

BOSTON BRANCH

On June 3, 1948 LIBRARIAN MANSON GLOVER presented SERGEANT WILFRED SIROIS, Head of Bureau of Photography, Massachusetts State Police, who, assisted by SERGEANT WILLIAM FARON, treated "The Value of Photography to the Police Department" A series of slides showed how photography aids in crime detection as well as in prevention and prosecution. Examples were finger prints, auto accidents, student pranks, skidding accidents, fires, robberies, bullet holes, breaking and entering, sewer murders, chinese lotteries and gambling, with all gruesome details omitted. The use of ultraviolet light, infra-red light, spectroscopy, X-rays, chemistry, and pathology was discussed as well. Any part of the state can be reached by a police photographer with photographic equipment within one hour of request. The speaker and his helper were given a rising vote of thanks, and the librarian commended for his choice of a subject of interest outside the plating field.

One application was read for the first time, and one for the second time followed by election to membership.

Five motions concerning the A. E. S. Annual Meeting and Constitution Revision were discussed and accepted. It was voted to submit the name of ANDEW W. GARRETT to the A. E. S. Executive Board for election to Honorary Membership in the Society.

The nominating committee presented the following slate which was unaimously elected:

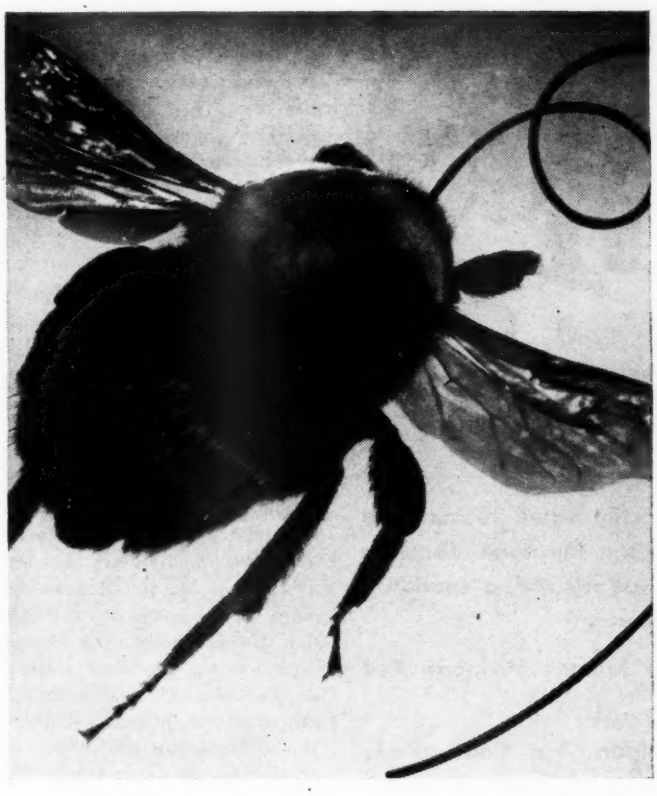
President—LOUIS V. GAGNON
First Vice-President — EDMUND S. JEVELY
Second Vice-President — EUGENE P. CARTER
Secretary-Treasurer—GEORGE P. SWIFT
Librarian—MANSON GLOVER
Sergeant-at-Arms—JAMES ANDERSON
Board of Managers—WILLIAM L. MEADE, WILLIAM B. HARVEY and ANDREW W. GARRETT

The new officers were installed by Past President George P. Swift.

The new Board of Managers was assigned the duties of a welfare committee, and the secretary instructed to send flowers to ARTHUR J. MINTIE, a long time member of the Branch who was operated on for gall stones at the Goddard Hospital, Brockton, Mass., and is recovering very well.

GEORGE P. SWIFT,
Secretary-Treasurer.

Put the



on burnishing problems

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Wyandotte Burnishing Compound 317 gives a high luster to parts of zinc, nickel and Monel metal. It works effectively in either hot or cold water. And because this viscous liquid contains no soap or inorganic alkalies, its burnishing action is not affected by the hardness of water. It rinses freely and leaves no scum on the work or in the barrel.

Wyandotte Burnishing Compound 320 gives a highly satisfactory finish to brass, copper, bronze, carbon steel or stainless steel. It is a soap-type compound and contains a non-toxic brightening agent. It may be used for burnishing with steel balls or for combined burnishing and burring with chips or stones.

Your Wyandotte Representative will be glad to tell you more about these and other specialized Burnishing Compounds in the *complete* Wyandotte line. All you have to do is give him a call.

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Now one quick look and *you're sure* it's a *Michigan* Abrasive DISC.

Why? For the same reason you can tell it's a Michigan Abrasive Belt! *Because it's red*—a sparkling red-wine color.

That's the famous Michigan Red Coat!

The Michigan Red Coat comes from a special process which covers each grain with a new *tough sharp surface.*

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Demand Michigan Red Coat All-Resin Fibre-Backed Abrasive Discs today.

(If you can't get Michigan Red Coat Discs or Belts, mail us this ad and your address.)

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ROLLS, SHEETS AND LAPPING COMPOUNDS

Michigan Abrasives are supplied in Belts, Discs, Rolls and Sheets—either paper or cloth backed—and in Silicon Carbide, Aluminum Oxide and Garnet—in full range of standard grit sizes.
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COLUMBUS BRANCH

DR. ROBERT C. WILLIAMS graphically described the behavior of drawing compounds and their chemical components at the June meeting. His description of the action of lubricants was enlightening and corrected any misunderstandings of the mechanical behavior of these materials during use. The chemical reactions of the materials with various metals were also described.

Dr. Williams touched on all phases of the lubrication of metal surfaces. His talk created many questions which will be answered by MR. SCHMELLING on July 9.

MELBOURNE BRANCH

The thirty-fourth regular meeting on June 28 was attended by forty-five members and seven visitors. One application for membership was received, and business of interest included a report from the Secretary relating to our Food for Britain drive.

The guest speaker was DR. A. M. L. MURRAY, who spoke on "Health Hazards in the Plating Industry", an address with a wide appeal to all present. Among many points made by the speaker were that the electroplater is exposed to fire, explosion and machinery hazards as well as physiological hazards and, therefore, should be exceptionally safety conscious. When discussing the effects of dust on possible lung damage, Dr. Murray stressed that there was no real danger to be feared from particles larger than 5 microns in size, which means that the dust that can be seen is not really dangerous—it is the unseen which matters. Later while discussing skin diseases the speaker mentioned that the adage, "Prevention is better than cure", applies most particularly to prevention of onset of dermatitis.

N. L. CARTER, *Vice-President.*

NEW HAVEN BRANCH

At the last meeting of the season on May 11 in the Sterling Laboratory of Yale University, PRESIDENT ED LUTHER thanked all his committees for their active participation during the past year.

The Chairman of the Nominating Committee, JACK BARRY, submitted a slate of officers which was approved unanimously:

President—DR. C. FRED GURNHAM, Consulting Chemical Engineer, Hamden, Conn.

Vice-President—HENRY B. SMITH, Metallurgist, R. Wallace & Sons, Wallingford, Conn.

Secretary-Treasurer—BERNARD J. GAFFNEY, Sargent & Company, New Haven, Conn.

Librarian—MALCOLM A. ORR, International Silver Company, Research Laboratories, Meriden, Conn.

Assistant Librarian—ROBERT T. SAMMET, Research Director, Mitchell-Bradford Chemical Company, Stratford, Conn.

Sergeant-at-Arms—GEORGE A. TRACCHIO, Bridgeport Thermostat Company, Bridgeport, Conn.

Board of Managers—CLARENCE GARNER, International Silver Company, Meriden, Conn.; DR. HENRY L. KELLNER, Lea Manufacturing Company, Waterbury, Conn.; EDGAR W. LUTHER, Underwood Company, Hartford, Conn.; WALTER T. LYNCH, Lux Clock Company, Waterbury, Conn.

TECHNICAL CHAIRMAN MALCOLM A. ORR introduced PROFESSOR B. F. DODGE of Yale University who spoke on A. E. S. Research Project No. 10, "The Disposal of Plating Room Wastes", of which he is Project Director. Professor Dodge explained the research in gathering past information available on cyanide, chromate and acid disposal and the investigations now under way.

B. J. GAFFNEY,
Secretary-Treasurer.

ST. JOSEPH VALLEY BRANCH

The last monthly meeting of the season was held on May 5 in the Empire Room of Hotel Elkhart. This meeting, which was designated as "Ladies' Night", started with cocktails at 6:30 P. M. and a dinner at 7:30. After the dinner, the ladies were shown movies while the men had their business and technical session.

The speaker of the evening, MR. WILLIAM PHILLIPS, together with MR. F. L. CLIFTON, both of the Research Laboratory Division of General Motors Corporation, gave a very interesting talk and demonstration of "Plating in Motion".

At the close of the Question Period, the new officers for 1948–1949 were installed by KEN HARLAN. The technical session was followed by a social gathering and special entertainment.

V. E. PETERSON,
Secretary-Treasurer.

SYDNEY BRANCH

The meeting on July 13 was opened by PRESIDENT E. J. WRIGHT and was attended by thirty-three members and visitors. Three new members were elected and seven applications were referred to the Board of Managers. A letter from the Adelaide Branch in which they asked us about the possibilities of the three Australian Branches holding a regional meeting in the near future was discussed; all were of the opinion that it may be possible, although the average distance between the headquarters of the three Branches was in the vicinity of six hundred miles.

After the business meeting the librarian introduced MR. T. FARLEY of Ducon Condensors Pty. Ltd., who gave a talk on the applications of condensors in the electroplating industry which was of great interest to the members.

(Concluded on page 966)

Membership Report

of the American Electroplaters' Society

Elections

ADELAIDE BRANCH: M. Byles

ALLENTOWN - READING BRANCH: C. C. Ackerman, James F. Bausch, Randolph Bitts, Ernest P. Geiger, Carson Kuhns, Vincent F. Leinheiser, A. H. Marks, John W. McCurley, Samuel McCurley, John P. Mihalih, Jr., Norman H. Miller, Paul A. Miller, Carl H. Neff, James Perrotto, James F. Riegel, Louis S. Siessmayer, Robert L. Southworth, Clarence L. Williamson, Ralph A. Yale, Frederick Zihilewsky, Joseph Zihelewsky

COLUMBIA BRANCH: J. Edwin Bride, Harold Quincel, Harry F. Ross, Earl Shaner, Andrew C. Turner

MELBOURNE BRANCH: E. N. Glass

PHILADELPHIA BRANCH: John Donaldson, Frank J. Krzos, Edgar A. Reed, Jr., John H. Richards, Jr.

SAGINAW VALLEY BRANCH: John O. Davies, Vaughan E. Davis

SOUTHEASTERN BRANCH: W. F. Fowler

SYDNEY BRANCH: H. Coates, F. Himmelhoch, C. C. Gibbs, C. J. McSweeney, L. C. Miller

OTHERS: C. F. Cheng, A. F. J. Day, Holmes B. Gabbert, Charles Stanford

Reinstatement

TOLEDO BRANCH: Walter Heigel

Transfers

John G. Benson from Columbus Branch; Roland Foulke from Philadelphia Branch; Rollie P. Durham from Jackson-Lansing Branch to Saginaw Valley Branch; W. A. Hopkins to Saginaw Valley Branch; F. O. Johnson to Saginaw Valley Branch; L. J. Minbiole to Saginaw Valley Branch; W. H. McCormick to Saginaw Valley Branch; W. Remington to Saginaw Valley Branch; D. Waits to Saginaw Valley Branch; A. Muehlenbeck to Saginaw Valley Branch; J. Farmer to Saginaw Valley Branch; R. J. Brink to Saginaw Valley Branch

Resignations

BALTIMORE-WASHINGTON BRANCH: Charles W. Jennings

PITTSBURGH BRANCH: Harold K. Work

ROCHESTER BRANCH: William J. Conley

Suspensions

NEW YORK BRANCH: Robert Corey, Kevin F. Duhamel, Karl Fifer, Samuel

(*Concluded on page 966*)

MEMBERSHIP CHART

	Membership May 1, 1948*	New Members	Net Change in Membership	Per Cent Net Change
FIRST GROUP				
CLEVELAND	190	10	+10	+ 5.3
TORONTO	143	5	+ 6	+ 4.2
PHILADELPHIA	205	6	+ 5½	+ 2.7
BRIDGEPORT	154	6	+ 4	+ 2.6
BOSTON	163	3	+ 3	+ 1.8
DETROIT	399	6	+ 6	+ 1.5
WATERBURY	128	2	+ ½	+ 0.4
NEWARK	273	5	+ 1	+ 0.4
LOS ANGELES	234	..	.....	.....
GRAND RAPIDS	140	..	− 2½	− 1.8
CHICAGO	453	8	−10	− 2.2
NEW YORK	270	1	−13	− 4.8
PITTSBURGH	149	..	− 9	− 6.0
HARTFORD	152	..	−19½	−12.8
SECOND GROUP				
SYDNEY	91	14	+15	+16.5
BUFFALO	96	4	+ 3½	+ 3.6
MILWAUKEE	120	6	+ 3½	+ 2.9
TWIN CITY	77	2	+ 1	+ 1.3
PROV.-ATTLEBORO	117	3	+ 1	+ 0.9
SAN FRANCISCO	77	..	.....	.....
DAYTON	90	..	.....	.....
INDIANAPOLIS	103	..	.....	.....
ST. LOUIS	103	..	.....	.....
NEW HAVEN	110	..	.....	.....
ST. JOSEPH VALLEY	98	..	− ½	− 0.5
CINCINNATI	80	..	− ½	− 0.6
BALTIMORE-WASH	97	..	− 4½	− 4.6
ROCHESTER	120	2	− 9½	− 7.9
THIRD GROUP				
SAGINAW VALLEY	38	5	+12½	+32.9
MELBOURNE	67	8	+ 8	+11.9
COLUMBUS	38	5	+ 4½	+11.8
LOUISVILLE	18	2	+ 2	+11.1
ADELAIDE	66	10	+ 7	+10.6
MONTREAL	63	3	+ 3½	+ 5.6
LANCASTER	46	1	+ 1	+ 2.2
SPRINGFIELD	53	..	.....	.....
ROCKFORD	59	..	.....	.....
JACKSON-LANSING	64	..	− ½	− 0.8
SYRACUSE	66	..	− 1	− 1.5
TOLEDO	73	..	− 2½	− 3.4
SOUTHEASTERN	49	2	− 5	−10.2
OTHERS	113	26	+21½	+19.3
TOTAL A. E. S.	5,249	146	+45	+ 0.9

Active Membership, August 5, 1948 5,294

*These figures are taken from the Annual Report and are subject to corrections as further information becomes available and checked.

Internal Stress

(*Continued from page 924*)

bility would suffer, but the experimental evidence shows no serious deficiency in this respect. Finally, and most significantly, the stress-relieved and restressed specimens actually had, for the most part, shorter penetration times than the corresponding as-plated specimens.

Summary

From the evidence presented in this paper it seems apparent that at least one chemical rate method of determining thickness is subject to errors due to internal stress and other but unknown physical properties of the deposit. The authors do not suggest that practical platers would often encounter deposits which were annealed at high temperatures as was done in this investigation, but they do offer the results as evidence that the physical properties of the deposit have important effects on a chemical rate method.

The experimental results emphasize the need for determining for each particular set of conditions under which work may be plated the factor which is to be used for the conversion of penetration time to thickness. In other words, while the jet test is intrinsically of sufficient accuracy for most purposes, it is explicitly so only when calibrated for the work at hand.

Since in a great many cases, particularly in the testing activities of the consumer, sufficient information may not be available to select the proper factor for testing a given item, the jet test and others of its kind are at a great disadvantage. This is especially true for nickel which is deposited from a wide variety of baths which in turn yield coatings having a bewildering range of mechanical, physical and structural properties.

Acknowledgment

The steel used as a basis metal in this investigation was supplied by the American Steel and Wire Company, Cleveland, Ohio, and the Harshaw Chemical Company of the same city furnished most of the chemicals employed in preparing the nickel plating solution.

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[1] Ballay, M., and Ginguene, J., Rev. Met. **42**, 15–21 (1945).

[2] Clarke, S. G., J. Electrodepositors' Tech. Soc. **12**, 1–18 (1936).

[3] Evans, U. R., "Metallic Corrosion, Passivity and Protection", 2nd Ed., Edward Arnold, London, Chapter VIII.

[4] Haring, H. E., Trans. Electrochem. Soc. **49**, 407 (1926).

[5] Soderberg, K. G., and Graham, A. K., Proc. Am. Electroplaters' Soc. **34**, 74–96 (1947).

[6] Phillips, W. M., and Clifton, F. L., ibid. 97–110.

[7] American Society for Metals' Handbook, p. 1646 et seq.

[8] Manual on Presentation of Data, American Society for Testing Materials, Philadelphia, Pa.

Branch News

(*Continued from page 964*)

Plans for the 1948 Social Night were found well in hand and an excellent evening is expected.

J. R. Godfrey, *Secretary.*

TOLEDO BRANCH

Mr. L. R. Eastman, Chemical Engineer, F. B. Stevens Company, Detroit, Mich., was the featured speaker at the meeting on May 6. He presented a most interesting paper on polishing and buffing methods and led an informal discussion on the same subject.

The Delegates were instructed to present a resolution on the floor of the Atlantic City Convention, requiring the A. E. S. President to appoint a committee to study ways and means to correct nickel and chromium shortages and report to the Branches.

G. H. Bergeman, *Secretary.*

TORONTO BRANCH

The elections of the Toronto Branch were delayed until June this year—first because we had the opportunity of a visit from A. E. S. President K. M. Huston in April, which was much too interesting to forego for a branch election, and then because our May meeting took the form of a Regional Educational Session at Niagara Falls.

It was decided to hold elections by mail; in this way 65 per cent of the members voted instead of the customary 35 per cent who could turn out to the meeting. There was, therefore, time at the June meeting for an interesting moving picture on the manufacture of paper presented by Mr. Archie Smith and for a comprehensive review of the past year's progress by President Blandy. At the end of the meeting Mr. Blandy was presented with a bridge table and four chairs in appreciation of the work he has done so well as president of the Branch for the last two years.

The new executive is as follows:

Past President—E. P. Blandy
President—Kergan Wells
First Vice-President—L. W. Wray
Second Vice-President—John Acheson
Secretary—Herbert Skelton
Treasurer—M. H. Green
Speakers' Chairman—Thomas Boaz
Program Chairman—Archie Smith
Recording Secretary—Lloyd Williams
Research Chairman—C. H. Short
Librarian—Donald Walker
Sergeant-at-Arms—Harold Bunting
Kergan Wells.

CORRECTION

Marvin W. Radom's (the new Detroit District Manager of American Buff Company) first name is not Martin as erroneously printed in the July issue.

Membership Report

(*Continued from page 965*)

Levine, Herbert Landau, John W. Leever, Walter J. Manson, Frank Mazza, Richard M. Quinn, Joseph N. Sardone, Anthony Suleski, David Spitzer, George Walters

PROVIDENCE-ATTLEBORO BRANCH: Gary Steven

ROCHESTER BRANCH: Ernest Fasson, Michael Fasson, Paul H. Good, Edward R. Hall, George Hibbard, William C. Meles, Bruno Oldack, David Penn, Paul Tufts

SOUTHEASTERN BRANCH: H. A. Dorward

TOLEDO BRANCH: Earl Batdorf, William Fair, Elmer Hurly

Deaths

BALTIMORE-WASHINGTON BRANCH: Armond Tschantre

TOLEDO BRANCH: Samuel Cole

A. E. S. News

(*Continued from page 962*)

Society to the Cincinnati, Pittsburgh, and Rochester Branches, winners of Branch Memberships Awards in their respective divisions.

These cups were donated by W. & S. Blackinton Co., Meridan, Conn., manufacturers of fine silverware. The manager

and plater of this company, Messrs, Thomas McKernan and Joseph McInerny, are both members of the Hartford Branch, A. E. S.

Measurement of Intrinsic Porosity

(*Concluded from page 920*)

of about 10 minutes as against the 200 minutes normal for that thickness in the absence of any corrosion. Such enormous increase of the porosity, unaccompanied as it is by any massive damage or analytically detectable loss of mass, cannot stem from an attack on the bulk of the metal. It rather suggests selective corrosive action at numerous "soft" spots, possibly thinnest metal partitions occluding cellular cavities within the deposit, which is insufficient to result in a significant loss of mass but amply sufficient to open up numerous channels and to increase very considerably the porosity and permeability of the foil.

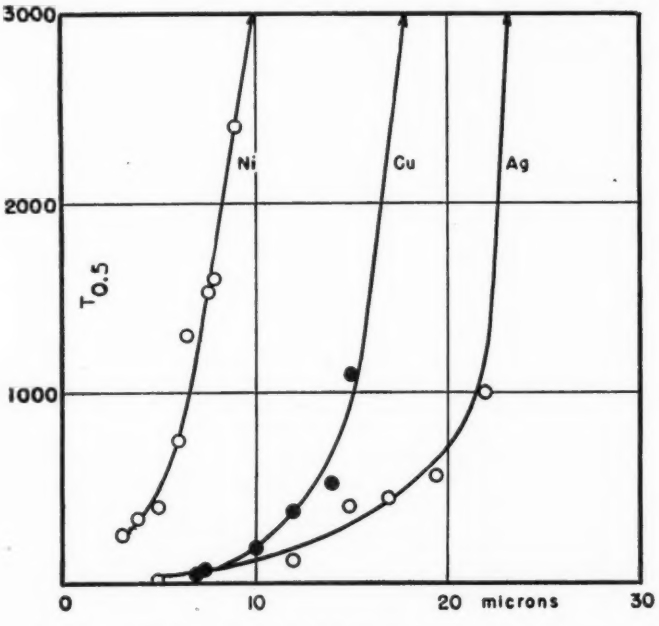

Fig. 5. Variation of standard half time $T_{0.5}$ with thickness of nickel, copper, and silver foils. Longer $T_{0.5}$ means lower porosity and vice versa

Incidentally, we have used this method to determine, unequivocally, the degree of "safety" of chemical spot test reagents. Thus, it was found that 50 g/l ferricyanide reagents, on 1 hour immersion, do not change the half-time of nickel foils with up to 0.2 g/l sodium chloride but do shorten it with larger amounts.

Porosity and Protective Value

It has been customary to link failure of protection against corrosion to the porosity of the protecting deposit. Whether such failures can be attributed to the systematic, intrinsic and true porosity as expressed by permeability to gases, appears problematic. Possibly, if gross defects of all sorts were rigorously absent and the deposits themselves were perfectly resistant to corrosion, failure would *eventually* set in at any rate, owing solely to the intrinsic porosity of the protective layers. Much in the same way, a living organism would eventually die of "natural causes", i. e., of normal exhaustion, even in the absence of disease. Practically, however, neither will a living organism be free from original defects or escape disease nor will an electrodeposit be free from gross defects or escape corrosion. Failure of some sort will, as a rule, occur as a result of original gross defects or of gradual corrosion of the protecting deposit *long* before the "natural" failure duet o the intrinsic porosity of the deposit is reached.

Conclusions

The low-pressure gas permeation method promises to be of use in two directions: first, as a method of quantitative comparison of the true porosities of electrodeposits produced under different conditions of electrolysis and/or subjected to different heat treatments, and, second, even more promising is the prospect of determining the progress of corrosive actions of various kinds in their initial stages, and, above all, the possibility of a quantitative expression on the half-time scale. The program of further research along these lines is obvious and is being pursued.

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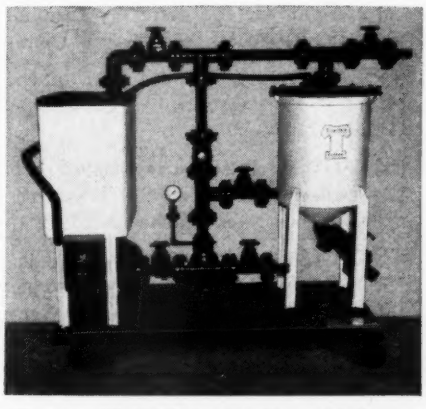

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P. O. Box 168. Jenkintown, Pa.

LOCAL BRANCHES

ADELAIDE, AUSTRALIA. Secretary, C. J. Cocks, 37 Myal Avenue, Kensington Gardens, S. A., Australia.

ALLENTOWN-READING meets third Thursday of each month. Secretary, H. E. Fennell, Box 628, R. D. 2, Reading, Pa.

BALTIMORE-WASHINGTON meets first Tuesday of October, December, February and April at National Bureau of Standards, Washington, D. C., and of November, January, March and May at American Hammered Piston Ring Company, Baltimore, Md. Secretary, Fielding Ogburn, Electrodeposition Section, National Bureau of Standards, Washington 25, D. C.

BOSTON meets first Thursday of each month in Hotel Statler. Secretary, Dr. George P. Swift, 53 Galen Street, Watertown 72, Mass.

BRIDGEPORT meets first and third Friday of each month in Barnum Hotel. Secretary-Treasurer, Joseph G. Sterling, 134 Colony Street, Bridgeport 8, Conn.

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CHICAGO meets second Friday of each month at 8 P. M. in Atlantic Hotel. Secretary-Treasurer, J. M. Andrus, 3701 Ravenswood Avenue, Chicago 13, Ill.

CINCINNATI meets fourth Wednesday of each month at 8 P. M. in Engineering Society Headquarters, McMillan Street and Woodburn Avenue. Secretary-Treasurer, H. Roper Davis, 3610 Zumstein Avenue, Cincinnati 8, Ohio.

CLEVELAND meets first Friday of each month in Cleveland Hotel at 8 P. M. Secretary-Treasurer, Harry Pochapsky, 24901 Euclid Avenue, Cleveland, Ohio.

COLUMBUS meets first Friday of each month at 8 P. M. in Battelle Memorial Institute Auditorium. Secretary-Treasurer, W. G. Hespenheide, 505 King Avenue, Columbus 1, Ohio.

DAYTON meets second Friday of each month in Engineers' Club. Secretary-Treasurer, Elmar W. Rehme, 505 Commercial Building, Dayton 1, Ohio.

DETROIT meets first Friday of each month in Hotel Statler. Secretary-Treasurer, F. L. Clifton, 16536 Inverness, Detroit 21, Mich.

GRAND RAPIDS meets second Friday of each month at 7:30 P. M. in Rowe Hotel. Secretary, Jacob M. Hage, 1327 Jefferson Avenue, S. E. Grand Rapids, Mich.

HARTFORD meets third Monday of each month in Hotel Bond. Secretary, Ralph D. Chase, 62 Bloomfield Avenue, Windsor, Conn.

INDIANAPOLIS meets first Wednesday of each month at Fox Steak House, 1207 Washington Street. Secretary-Treasurer, Dr. A. M. Max, 6157 Park Avenue, Indianapolis, Ind.

JACKSON-LANSING meets second Tuesday of each month at Home Dairy Company in Lansing. Secretary-Treasurer, U. J. Forsyth, 1816 Ada Street, Lansing 10, Mich.

LANCASTER meets second Friday of each month at 8 P. M. in Thaddeus Stevens Industrial School. Secretary-Treasurer, Chester W. Smith, c/o American Wire Fabrics Co., Mt. Wolf, Pa.

LOS ANGELES meets second Wednesday of each month at 6:30 P. M. in Scully's Restaurant. Secretary, George M Kent, 791 E. 15th Street, Los Angeles 21, Calif.

LOUISVILLE meets third Wednesday of each month in the 235 Club, 235 S. 5th Street. Secretary-Treasurer, Stanley J. Beyer, c/o Hart Manufacturing Company, 2006 North Western Parkway, Louisville 3, Ky.

MELBOURNE, AUSTRALIA meets fourth Monday of each month at 8 P. M. in Chamber of Manufactures, 312 Flinders Street. Hon. Secretary-Treasurer, John J. Dale, c/o Munition Supply Laboratories, Maribyrnong, Victoria, Australia.

MILWAUKEE meets first Friday of each month in Red Araow Club, 774 N. Broadway. Secretary-Treasurer, Harry J. Krueger, 1333 S. 71st Street, Milwaukee 14, Wis.

MONTREAL meets first Tuesday of each month in Mount Royal Hotel. Secretary-Treasurer, B. Mendels, c/o Empire Glass Works Company, 425 River Street, Verdun 19, Quebec, Canada.

NEWARK meets first and third Friday of each month at 8 P. M. in Hotel Robert Treat. Secretary-Treasurer, George Wagner, 1130 S. Long Avenue, Hillside, N. J.

NEW HAVEN meets second Tuesday of each month alternating between Sterling Chemistry Laboratory, Yale University, and Hotel Taft. Secretary-Treasurer, B. J. Gaffney, 40 Filbert Street, Spring Glen, Hamden 14, Conn.

NEW YORK meets second and fourth Fridays of each month in Hotel Pennsylvania. Secretary-Treasurer, Franklyn MacStoker, 25 Princeton Street, Garden City, L. I., N. Y.

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PITTSBURGH meets third Thursday of each month at 6:30 P. M. in Keystone Hotel. Secretary-Treasurer, G. B. Bowman, 1510 Ridge Avenue, Coraopolis, Pa.

PROVIDENCE-ATTLEBORO meets third Monday of each month in Providence-Biltmore Hotel. Secretary-Treasurer, Dr. Edward A. Parker, 15 Vale Avenue, Cranston 10, R. I.

(Continued on page 970)

A. E. S. Publications

"The Fundamentals of Electrochemistry and Electrodeposition" by Samuel Glasstone. Price $2.50.

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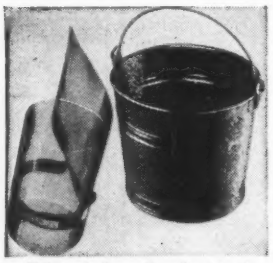

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Branch Directory *(Continued from page 968)*

ROCHESTER meets third Friday of each month in Hotel Seneca. Secretary, James Weaver, 884 Whitelock Road, Rochester 9, N. Y.

ROCKFORD meets second Monday of each month in Faust Hotel. Secretary, Vern T. Wissen, Forest Hills Road, Rockford, Ill.

SAGINAW VALLEY meets for dinner at 7:00 P. M. and meeting at 8:00 P. M. at Rollie McNivens, Frankenmuth, Mich., second Wednesday of each month except October, January and April (third Wednesday) and December (no meeting). Secretary, L. J. Minbiole, 533 Copeman Boulevard, Flint 4, Mich.

SAN FRANCISCO meets second Thursday of each month, alternating between El Jardin Restaurant, 22 California Street, San Francisco, and El Curtola Restaurant, 510 17th Street, Oakland. Secretary-Treasurer, Fred P. Dartt, 1222 42nd Avenue, Oakland 1, Calif.

SPRINGFIELD meets fourth Monday of each month in Hotel Charles. Harold Oehler, Pleasant Street, Granby, Mass.

ST. JOSEPH VALLEY meets first Wednesday of each month at 8 P. M. in Hotel Elkhart, Elkhart. Ind. Secretary-Treasurer, Victor E. Peterson, 1641 Hickory Street, Niles, Mich.

ST. LOUIS meets second Wednesday of each month in York Hotel. Secretary-Treasurer, E. R. Hunleth, 4415 Michigan Avenue, St. Louis, Mo.

SOUTHEASTERN meets second Thursday of each month in Robert Fulton Hotel, Atlanta, Ga. Secretary, William Weymouth, 173 Clay Street, S. E., Atlanta, Ga.

SYDNEY, AUSTRALIA. Secretary-Treasurer, John R. Godfrey, P. O. Box 31, Auburn, N. S. W., Australia.

SYRACUSE meets fourth Monday of each month in Bowne Hall, Syracuse University. Secretary, Vincent P. McConnell, 269 Whittier Ave., Syracuse 4, N. Y.

TOLEDO meets first Thursday of each month at Commodore Hotel. Secretary, Herbert A. Shelton, c/o John Inglis Company, 14 Strachan Avenue, Toronto, Ont., Canada.

TORONTO meets second Friday of each month in Royal York Hotel. Secretary, Leonard W. Wray, 105 Ronan Avenue, Toronto 12, Ont., Canada.

TWIN CITY meets first Monday of each month, October through June, in Covered Wagon Cafe, Lodge Room, 114 S. 4th Street, Minneapolis. Secretary-Treasurer, Robert L. Buckley, 318 Builders Exchange, Minneapolis 2, Minn.

WATERBURY meets second Friday of each month in Elton Hotel. Secretary-Treasurer, Spencer L. Henn, P. O. Box Dr. B, Cheshire, Conn.

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